DISCOVERY

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Notes of the Month.

Scottish hospitality and delightful weather combined to make last month's meeting of the British Association, at Aberdeen, one of the most successful in recent years. The presidential address, delivered to an audience of close on three thousand, excited the widest interest, not only among the members of the Association, but among the general public; and although the President led his hearers into the farthest realms of philosophic science, his closing words were fraught with the gravest significance also to the lay mind; and he provided wise indications of the way that Science might go, and the way it should go. Sectional meetings were remarkably well attended; visits to works, quarries, and markets were especially popular; and the excursions into the beautiful surroundings of Aberdeen were made in genial sunshine. In the social activities of the week the Association owes the deepest gratitude to the hospitality and organising powers of both the civic and academic authorities.

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Two suggestions might be made: there appeared to be a certain amount of "parochialism" among the sections of the Association, which might be lessened on future occasions by multiple-section meetings; and it was felt in some quarters that something might be done for those ratepayers (the Association's hosts after all) who could not see their way to becoming subscribing members, but who evidently took a great interest in the proceedings. This popularisation might be a sound adjunct to the policy of the Association, which is confessedly the Advancement of Science.

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Entries for the *Discovery* Travel Competition, announced in our June issue, showed one interesting charge from those of last year. Prizes were offered for the best essays on travel in any part of the world, and those essays received seem to indicate a narrowing of the circle of travel, the majority of the entrants having chosen to describe European experiences. The first prize to the value of £5 is awarded to Mr. A. J. Harthan, of Sheriffs Lench, Evesham, whose original holiday on the Norwegian coast will be found described in the next issue of *Discovery*. Dr. P. L. Giuseppi, of "Trevose," Felixstowe, who was successful in winning last year's first prize, is awarded the second prize of £3 for an essay on the Sierras of Spain and their flora, which we hope to publish later. The Editor of *Discovery* thanks all those others who entered for the competition, and wishes them better success on future occasions.

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The four new Bird Food Charts (Jackdaw, Kestrel, Nightjar, Yellowhammer), published by the Royal Society for the Protection of Birds, set forth clearly and concisely the general diet of these species of wild birds, by showing in colour the percentages of their food, whether useful, harmful, or neutral in relation to the interests of man. The figures are based principally on the scientific investigations of Dr. W. E. Collinge and quoted by permission from his work *The Food of Some British Wild Birds*; and each chart has a coloured picture of the bird, by Mr. Roland Green. The species previously dealt with are Chaffinch, Song-Thrush, Hedge-Sparrow, Skylark, Blue Tit, Great Tit, Kingfisher, Green Woodpecker, Cuckoo, Dipper, Lapwing, and Barn Owl. The charts can be had from the Society, 82, Victoria Street, S.W.1, at 4*d.* each post free, or the series of 16 by post at 4*s.* 4*d.*

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The Gaekwar of Baroda Greater-India Research Expedition, of which the Field Director is Dr. H. G.

Quaritch Wales, begins work in the field in the autumn of 1934. Its object is to make a close study of one of the last remaining archæologically-unexplored regions in Asia—a region which there is reason to believe holds the key to the full understanding of the early eastward expansion of Indian cultural influences. Unlike the more northerly routes through Central Asia, which have been carefully explored by Sir Aurel Stein and others, the passes through the jungle-clad mountain ranges of Lower Burma and Southern Siam are still, from the archæological point of view, a virtual *terra incognita*. It was probably about the 6th century B.C. that the first Indian voyagers reached the eastern shores of the Indian Ocean; and conclusive proof exists that successive waves of Indian influence from that time onwards penetrated to the east not by the Straits of Malacca but through the mountain passes of Lower Burma and Southern Siam. Having founded settlements there, these early pioneers voyaged further afield across the Gulf of Siam to a land where they were the means of founding the great kingdoms of the Khmers and Chams, the flowering of whose civilisations in the magnificent monuments of Cambodia and Annam made manifest to all the greatness of Indian cultural achievement in Indochina. But, though the final development has now been revealed, the way thither from the Indian motherland is as yet shrouded in mystery. References in the accounts of early Chinese travellers, and the few inscriptions hitherto found, have indicated the existence in the early centuries of the Christian era of powerful kingdoms in Lower Burma and Southern Siam which finally passed on the torch of Indian culture to the more distant empires of the Khmers and Chams. The reports of travellers who have in modern times passed along these difficult and almost disused mountain routes give ground for the conviction that a closer exploration of the ancient settlements that are known to exist will bring to light remains of purely Indian character and great archæological importance.

Ivory perfume-flask, discovered at Lachish.

The Wellcome Archæological Research Expedition to the Near East will resume operations at Tell Duweir (Lachish) early in October. It is hoped to begin work on the great Jewish palace-fort on the summit of the *tell* and to complete the clearance of the lower levels of the temple; while the Early Copper Age city will be further explored. The ivory perfume flask illustrated on this page was described by Mr. E. N. Fallaize in the August number of *Discovery*, in an article in which the progress of last season's successful work was fully outlined. Further research has been employed on deciphering the inscription on the large pottery ewer found below the *tell*, details of which are included in this issue on page 288.

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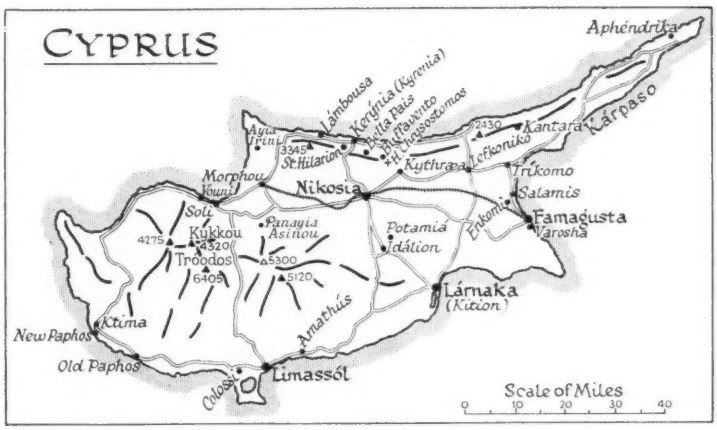
The Annual Report of the Food Investigation Board for the year 1933 (H.M. Stationery Office, 4s.), issued by the Department of Scientific and Industrial Research, reviews the aims of the research work, now costing about £45,000 a year, carried out by the Department on the transport and storage of foodstuffs. Work of practical value to British shipping, which carries by far the greater part of our foodstuffs, is being carried out in the experimental ship's hold at the Ditton Laboratory. "With this unique piece of equipment, it has been possible to compare the efficiency, for the carriage of cargoes of foodstuffs, of the different systems of refrigeration in current use, to determine the relative value of different methods of dunnaging cargoes, to evaluate such practically important biological constants as the thermal capacity of a stack of apples, the rates at which it generates heat and carbon dioxide, and the rate of evaporation from it, and to study on a semi-commercial scale the transfer of heat from fruit to air and from air to pipes." The Report adds that it should not be overlooked that the results of the work in the experimental hold are in the main equally valuable in the development of storage on land as they are to overseas transport; and it emphasises the importance of basic investigations for increasing the knowledge of the fundamental properties of foodstuffs.

The Antiquities and Monuments of Cyprus.

By Sir George F. Hill, K.C.B.
Director of the British Museum.

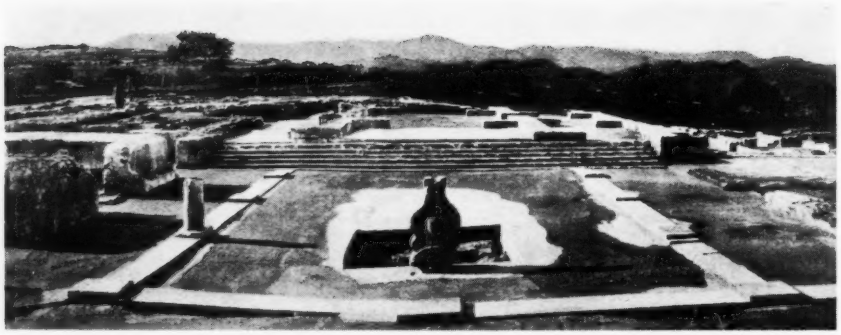
Cyprus, the Cinderella of British Colonies, seems at last likely to come into its own. Sir George Hill tells a story of shameful neglect in the past; but the activities of Lord Mersey's committee and the example of Rhodes should put an end to that, and Cyprus may well become a regular port of call for cruisers.

SINCE Cyprus was taken over by the British in 1878, such attention as it has received from archæologists has been almost exclusively directed to its pre-Byzantine antiquities. There have, it is true, been surveys which cover the later period. The most ambitious of these is George Jeffery's "Description of the Historic Monuments of Cyprus" (1918), the author of which is chiefly interested in the Gothic period; there is also Enlart's brilliant "L'Art Gothique et la Renaissance en Chypre" (1899). There have been separate investigations, like Tankerville Chamberlayne's never-completed collection of funerary inscriptions, "Lacrimæ Nicossienses" (1894). But in the last century archæological research in the post-classical period was even less organized, even less recognized academically, than it is now. Cyprus never had a Renaissance in the Italian manner, so that amateurs of art found nothing there to their taste except the antiques of which the carelessness or connivance of the authorities, and the unscrupulous methods of pseudo-archæologists like Luigi Palma di Cesnola, assured an almost inexhaustible supply. As to later remains, the attitude of too many of the people responsible may be indicated by the remark of a high official who was told that the roof of one of the finest Gothic buildings in the island was about to fall. "Let it," he said, "it will make good road-metal." So too the Venetian walls and bastions of Nicosia, admirably picturesque and by no means too badly ruined for preservation, are, or were until a few months ago, being flattened out to make a boulevard in the Viennese fashion, though the streets of the town which they enclose are seldom more than 15 feet wide. It is to be hoped that a new era is now inaugurated, marked by the interest in the affairs of the island which the Colonial Office is now taking, and by the popular sympathy with the needs of the monuments of which there has recently been much evidence in the English press.



This map shows the principal ancient sites of Cyprus. The grouping of the medieval castles along the Northern mountain-ridge is noticeable.

Very little in the way of monuments of the pre-Byzantine period remained standing above ground, at the time when excavations began. Such examples as the granite monolithic columns at Paphos, evidently brought from Egypt about the 4th century A.D., were exceptional; and even they are not certainly *in situ*. But the ancient sites were innumerable. The Society for the Promotion of Hellenic Studies was founded in 1880, and it was natural that British excavators should turn to classical sites such as Old Paphos and Salamis. So the Ptolemaic Temple at the former and the two fora and other sites at the latter were cleared. Much valuable information was obtained, but, the excavations at Old Paphos once over, the site was left to itself, and has been a quarry for the neighbourhood ever since. It is a model of how excavated sites should not be treated. Salamis is in slightly better case, because the area is enclosed by the Forestry Department; but no attempt has been made to keep the excavations clear or render them intelligible. Other excavations, such as those by the British Museum at Amathus and Enkomi, concerned mostly cemeteries and not monuments. Much good work on the antiquities generally was done by



The peristyle court of the palace at Vouni : reproduced from Dr. Gjerstad's monograph published by the Swedish Institute in Rome in "Corolla Archæologica."

J. L. Myres. But it was not until quite recently that a really effective example in methods of excavation was set by the Swedish expedition, which between 1927 and 1931 dealt with various sites, ranging from the Stone Age to Roman times, the most important for our purposes (for we may ignore the prehistoric and geometric periods down to about 650 B.C.) being Ayia Irini, Kition and Vouni. At the first place (in the N.W. of the island) a remarkable group of some 2,000 votive terracotta figures, statuettes and full-size statues, the earliest dating from about 600 B.C., was discovered in position surrounding the altar. This is the beginning of Cypriote sculpture. The resemblance to Syrian art is explained by the excavators as due not to direct Syrian influence, but to common racial and cultural factors. It is native Cypriote in origin. So too the Egyptizing and Phœnicizing character of much of the art of South Eastern Cyprus in the early archaic period must not be allowed to disguise the fact of its Cypriote origin. (The Egyptizing elements, by the way, seem to be not of pure Egyptian origin, but to be transmitted through Phœnician channels.) Throughout its history, Cypriote art has had a definite Cypriote character, which emerges through the foreign skins in which it is clothed. It is only unfortunate that it has never reached a high level, or produced conceptions from which other schools might draw inspiration.

The later archaic sculpture discovered by the Swedes in the second temple at Ayia Irini and at Kition shows Greek-Ionic influence, but is none the less native Cypriote. So too, as a striking instance, is the late archaic limestone statue from Vouni, dating about 500-480 B.C., whose head strangely recalls French Gothic of the 13th century A.D.

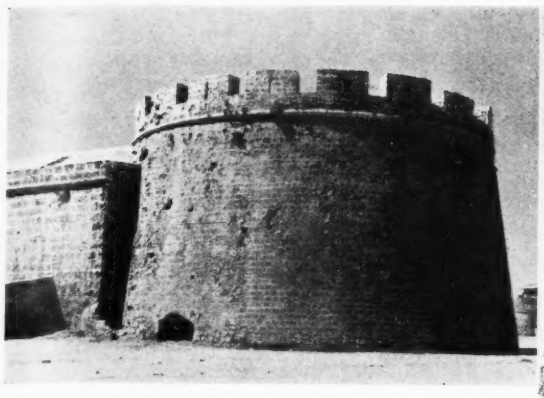
The palace at Vouni, on a great bluff some 800 feet high, overlooking the sea near the ancient Soli on the north coast of the island, is the most remarkable excavated series of buildings in Cyprus. The palace, the earliest part of which dates from the beginning of the 5th century, has been left in admirable condition, and is adequately guarded from marauders—a model of method which all future excavators should be compelled to copy.*

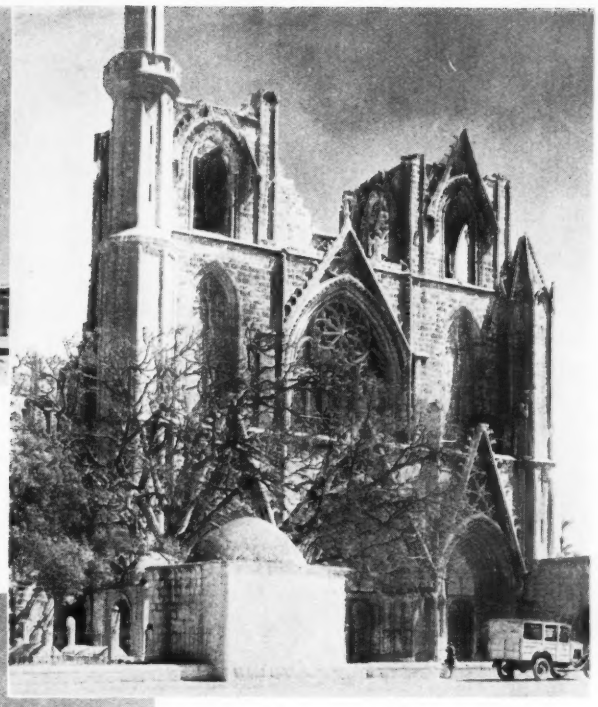
We may pass over the remainder of the pre-Roman period, mentioning only the too much admired head of "Apollo" from Potamià, attributed to the 4th century, in the Cyprus Museum, as an instance of the faculty of the Cypriotes for etiolating the Greek conceptions by which they were inspired. The most important sculptural remains of the Roman period, on the other hand, show no Cypriote characteristics ; the sarcophagi, probably of Hadrianic date, from Bella Pais and at Varosha—the latter now the tomb of an English official, and lying disgracefully neglected in a spot used by the neighbourhood as a privy—and the splendid bronze portrait statue of Septimius Severus in the Museum can hardly be of native workmanship.

The remains of buildings of the early Christian and Byzantine periods (once so numerous and famous as to give to Cyprus the name of the Holy Island) offer problems of such extraordinary difficulty, and, where they have survived in the shape of churches, are so much involved in later transformations that it is impossible to give any clear account of them here. We must await the survey by Professor Sotiriou of Athens, who has published a summary of the material in the Proceedings of the Athens Academy for 1931. The uncertainty prevailing about them may be gauged by the fact that churches which Enlart regarded as romanesque (as that at Aphendrika in the Carpass) are dated by Sotiriou to the 6th or 7th century. The most important examples of this period still standing are the churches of St. Barnabas outside Salamis and of St. Lazarus at Larnaca, originally cruciform buildings with five domes. At St. Barnabas Mr. Mogabgab is making important excavations, laying bare the ancient apse and remains of a marble mosaic pavement.

The Byzantine style proper (from the 10th century onwards) is plentifully represented in Cyprus, with local

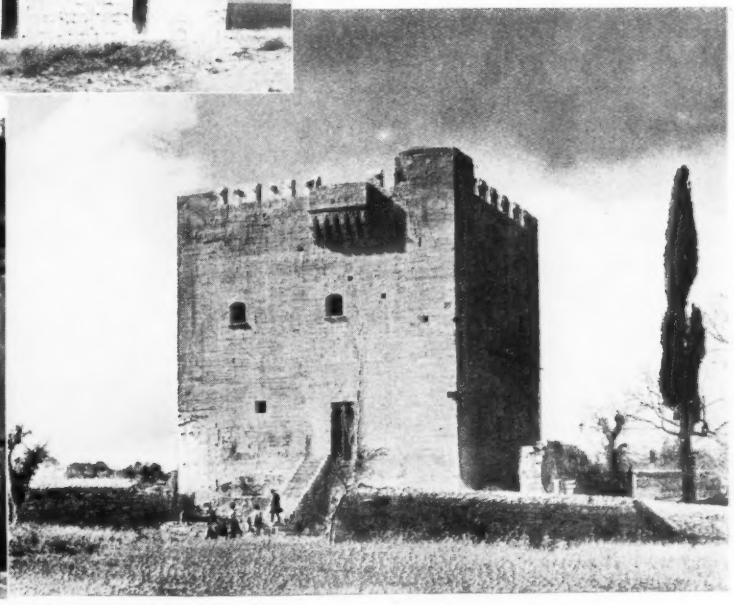
*An admirable summary account of the Swedish excavations, pending the full publication, is given by Gjerstad in *Die Antike* IX, 1933.





(*Above*) *The "Othello" Tower in the walls of Famagusta.* (*Centre*) *The late Byzantine church at Lambousa.* (*Below*) *St. George of the Greeks, the Orthodox Cathedral at Famagusta, ruined by bombardment and neglect.* (*Photograph by Major Seymer.*)

(*Above*) *Famagusta Cathedral, now a mosque, with its "Gothic" minaret.* (*Below*) *The mediæval keep of Colossi.*



variations. A beautiful example of its latest development (though he would be a bold man who gave it an exact date) is the derelict church at Lambousa, with single barrel-vaulted nave and dome, to which a " Gothic " narthex was added later.

Documentary evidence as to the building of the churches is hardly existent until we come to the Lusignan days (1192-1489), and then it is scarce. Byzantine art, especially in the provinces (and here in Cyprus the Byzantine tradition in painting persists down to recent times), is ultra-conservative, and many years of study will be required before any canons of dating will be fixed. The earliest dated frescoes appear to be those at Panayia tes Asinou, of 1099 and 1105 ; but how far do they date the churches themselves, and how far have they been restored ? These painted churches, especially in the hill districts, are extraordinarily numerous, and the frescoes, in spite of exposure to the elements, are sometimes in remarkable preservation, as, for instance, the Entombment, probably of the 12th century, at Ayios Chrisostomos, which has been open to sky and air for at least two centuries. Comparatively few of the frescoes have this quality, but they are often of great iconographic interest, and call for careful study on the lines which have been followed with such success by Buckler and Seymer in their monograph on the already mentioned church of Asinou. The gay red, blue and gold decoration of the iconostases which are characteristic of these churches strikes a very cheerful note ; it is unnecessary, and would be unkind, to criticize their workmanship by too high a standard. The finest of all is probably that which was long ago removed to the Victoria and Albert Museum.

The Turk as a Preserver.

The great Gothic churches at Famagusta and Nicosia ; the most beautiful of all Cypriote monuments, the ruined monastery of Bella Pais near Kyrenia ; and the romantically situated castles at Saint Hilarion, Buffavento and Kantara, afford incomparably fascinating illustrations of the exciting history of the island under the Lusignan dynasty. But, except where Christian churches have been taken over by the Turk for use as mosques, they are nearly all in the most lamentable state of decay and neglect. Stripped though they may be of Christian decoration, buildings such as the great mosques at Nicosia (the former cathedral, begun early in the 13th century) and at Famagusta (from the beginning of the 14th) are in no further danger of structural decay, although the latter has been provided with a new and expensive minaret in the Gothic style, which is apparently not used for the purpose for which it was built. But the gaunt skeleton of St. George of the Greeks, the Orthodox Cathedral at Famagusta, dating from the 14th century, rears its broken arches and vaults as a standing memorial of the ruin caused by bombardment, and a protest against public neglect. In addition to St. George of the Latins on the east of the city, a string of more or less ruined, if less impressive, churches stretches out from the centre of the city towards the north-west bastion : the so-called SS. Peter and Paul (a rather clumsy but very interesting 15th or early 16th century Gothic building, employed when we visited it last spring for packing oranges for export) ; the Nestorian church, St. Anne's, St. Mary of Carmel, the church of the Armenians, and others unidentified. Although modern buildings are spreading over the once deserted area of the city, much of it still remains unoccupied, and offers a splendid opportunity for laying out as an archæological park.

Conservative Craftsmen.

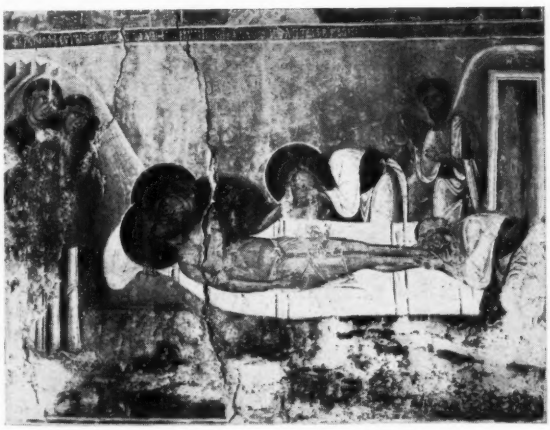
At Nicosia, besides the mosque of Ayia Sophia already mentioned, there are a number of churches, such as Our Lady of Tyre, St. Nicolas, the Augustinian church (the Omerieh mosque) and especially the fine church of St. Catherine and the early 16th century Bedestan, once the orthodox metropolis, now in a sad state of decay. Buildings such as the last take us out of the Lusignan into the Venetian period, but there is no abrupt change from the earlier Gothic. The conservatism which characterizes the island in regard to fresco-painting is equally noticeable in construction. Detail which in England would be put down to the Norman or Early English period is found on churches of the late 15th century, a phenomenon which has been noticed in other regions, such as Southern Italy, where Gothic is an exotic. So an unidentified 15th century church at Famagusta (Enlart's No. 11) has perfectly good romanesque zigzag carving on its West door, and Enlart illustrates the same feature from an 18th century house in Nicosia ; while dogtooth ornament is common on 14th and 15th century mouldings. So that while such a West front as that of the mosque at Famagusta looks at first sight merely French, there is something a little strange about it ; and a superficial resemblance to Lichfield which has been remarked merely shows that it is not quite pure French. Again, much as we may admire the architectural lay-out and construction of the noble refectory at Bella Pais, and feel assured that it was designed by a pure French architect, versed in all the subtleties of his craft, examination shows that provincial craftsmen must have been employed on the detail.

The cities of Famagusta, Kyrenia, and Limassol had their castles ; but the fortresses which appeal most to

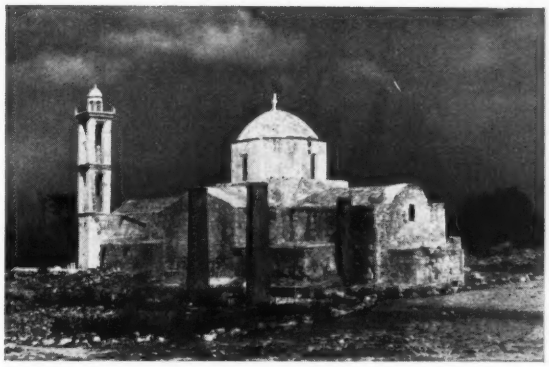
the visitor are the isolated strongholds already mentioned (of which Saint Hilarion, dating from the 13th century, is not surpassed in beauty of natural setting or romance of association by any other medieval building) and also Colossi of the Knights of St. John. At this place the beautiful 15th century keep is now in the hands of the English branch of the Order, who will doubtless in future see to it that such restoration as is undertaken will be judicious in the true sense of the term.

The fortifications of Famagusta include the "Othello" tower and the magnificent Martinengo bastion, the work of Giovanni di Michele Sammichele, who died in 1559. Military architecture has nothing to show more impressive than this in the skill with which the elaborately curving galleries are planned and vaulted. The walls and bastions of Nicosia, so far as they have not been destroyed, are merely earthworks revetted with stone; but the ensemble of the works and the trees planted round the walls is the most attractive feature of the capital, and one would like to see it laid out in the way in which similar remains have been treated by the Ancient Monuments branch of the Office of Works in England.

That indeed, the need for proper attention and conservation under an adequate Antiquities Service, is the lesson which no intelligent person can fail to learn from a visit to Cyprus. Fortunately the present Governor and the Secretary of State for the Colonies have already shown that they are keenly aware of the needs of the Colony in this, as in other respects. But support, in the shape of subscriptions to the work of Lord Mersey's Committee, is due from all those who have visited what is certainly the most neglected and one of the most beautiful of British possessions.



Fresco of the Entombment, in the Byzantine manner, from Ayios Chrisostomos.



Roman columns of Egyptian origin outside the Byzantine church of New Paphos.

[Author's Note:—Lord Mersey's Committee has recently issued an appeal for subscriptions (which may be sent to Lloyd's Bank, 6, Pall Mall, S.W.1) to save the most urgent cases of ruinous monuments, taking as its text the Report drawn up by Sir Charles Peers after a visit on behalf of the Committee to the island this Spring. The present writer at the same time was invited to report to the Secretary of State for the Colonies on the administration of antiquities in the island and on the needs of the Cyprus Museum, and the Archæological Joint Committee drafted suggestions for the modification of the Law of Antiquities, bringing it more into accordance with modern requirements. There is every prospect that a properly organised Department of Antiquities, under a competent Director, will soon be set up. Copies of Sir Charles Peers's Report are in the Libraries of the British Museum and the Society of Antiquaries. The present article owes much to it; and acknowledgment must also be made for the illustrations to Mr. C. J. P. Cave, from whose remarkable series of photographs the majority of them are selected.]

"Coppered" Coins in Cyprus.

Dr. Stanley Willimott, Government Analyst in Cyprus, recently reported to the Institute of Metals the discovery of authentic Greek and Roman coins which should have been silver, but had the appearance of bronze. Investigation proved that they were silver, the surface change being due either to galvanic action in the presence of water containing copper sulphate as an electrolyte; to electrolytic deposition of copper on silver; or to pyro-oxidation of the copper in the coins as the result of a chance fire.

Astronomy and Modern Thought.

By The Rev. T. E. R. Phillips.

In the Fison Memorial Lecture, reprinted here, the Rector of Headley, eminent alike as an astronomer and as a churchman, sums up the ultimate relation between Science and Religion. Religion is concerned with a world of values, and the evidence as to the fate of the material Universe, staggering though it is, is a matter of indifference to it.

At the Century of Progress Exposition held last year at Chicago the floodlights in the grounds, at the suggestion of Professor Frost, Emeritus Director of the Yerkes Observatory, were started by the energy of the rays of light from the star Arcturus, shining through the object glass of the great 41-inch refractor. They had begun their journey at the close of the World's Fair held forty years previously, so that the two exhibitions were linked up in a rather sensational way. An equally remarkable circumstance was the furnishing of the necessary impulse for lighting up the same grounds by the rays from the planet Saturn, collected by a telescope in Florence, and transmitted thence by radio to Chicago on the occasion of a visit from the Marquis Guglielmo Marconi. Such things are a striking symbol of the close association, or interpenetration, of two great departments of science, astronomy and physics.

We recognise to-day the *unity* of science. Whatever divisions we may arbitrarily make for purposes of convenience, we realise that there are fields of research which cannot be regarded as bounded by rigidly defined contours. Of this astronomy and physics, with mathematics common to both, provide a specially striking illustration. Who can draw a line and say that on one side of it is the realm of astronomy and on the other that of physics? It is, indeed, in the close partnership of the two sciences that some of the greatest advances in knowledge have been and are being achieved.

The Expansion of Research.

We concern ourselves especially in this lecture with Astronomy, though we use the word in the broad sense which I have indicated. We cannot, of course, survey the history of the science, but it will not be amiss if for a few moments we note how radically the general trend of research has changed its direction and widened its scope. Throughout the ages, from the Ancients to the 18th century, interest was mainly centred in our planetary system. First the Earth, and then the Sun, was regarded as the centre or pivot of the Universe, and the efforts of astronomers were expended chiefly in unravelling and explaining the planetary movements. It was, of course, natural that the stars should be largely neglected, for, beyond the fact that their apparent immobility made them useful reference points on the background of the sky, there was little that could be done with them, and it was found that the newly invented telescope was better employed in the study of bodies nearer home. Then came William Herschel, the "father of sidereal astronomy," as he has been justly called. Possessing remarkable skill in the grinding and figuring of specula and the construction of telescopes, and fired with the desire to sound the depths of space and learn the form and extent of the Universe, he turned men's thoughts to more majestic problems, and laid the foundations of many lines of study which proved abundantly fruitful in later times.

To-day we have a more extensive view than was possible even for Herschel. This is not to say that the older problems are now completely solved or that they are considered to be of small importance. Indeed, the birth of new ideas, the opening up of new methods of study, and the invention of new types of apparatus have sent many an astronomer back again to the investigation of some of those questions which so greatly interested men of the older schools.

The study of the Sun, *e.g.*, in the light of the new ideas which modern physics has revealed is to-day one of the most important departments of astronomical research; or—to give another illustration from that field with which I am myself more directly concerned—we note the combination of visual observation at the telescope with the employment at some of the great observatories of the resources of photography, spectroscopy, radiometry, and polarimetry in an organised effort to discover the physical conditions of the planetary surfaces and the nature and movements of their enveloping atmospheres.

Beyond the Galaxy.

But although there is still much that we want to know about the bodies of our own little celestial family—although "the man in the street" may still ask the astronomer when he meets him: "Do you think there are people on Mars?"—as if that were the most important question in Astronomy, and one in which, of course, all astronomers must necessarily be interested, the real scope of study immeasurably transcends the boundaries of the solar system. It exceeds even the limits of that wonderful system of stars which Herschel studied so

assiduously, and of which the fundamental plane is familiar to us as the Galaxy or Milky Way—a zone of shimmering light girdling the sky, with its many thousands of millions of suns scattered through distances so great that light, with its speed of 186,000 miles a second, requires from units to many thousands of years to traverse! Here, however, the last remnant of domesticity does seem to be left behind. We are still in some sense "at home" so long as we remain in the Galaxy, for our sun is, after all, one of the constituent suns which make up its clouds of stars. But we are hurried on—further and further out into space—to those exceedingly remote objects—the great *nebulæ*.

What are these objects? It may be recalled that they were formerly known as the *white nebulæ*. This was to distinguish them from those of a slightly greenish hue, like that mysterious object in the sword of Orion (M. 42) and others, whose light when analysed gives a bright-line or gaseous spectrum. These latter nebulæ are situated in our own galactic system, and are often associated with its streams of stars. The white nebulæ were called by Herschel "Island Universes," because he supposed them to be distant systems of stars, though subsidiary to the great stellar system of the Galaxy. And it is interesting to note how astronomical opinion, at one time sceptical, has swung round in recent years to what is very like Herschel's view.

Universes in the Making.

At any rate, it seems certain that these objects—whose number must run into many millions—are either already systems of stars, or such systems in the making. Their spectra are "continuous" and show all the colours. In those of the nearer nebulæ dark absorption lines are seen crossing the continuous ribbon of light as in the ordinary spectrum of a star, and in some cases there are bright lines, too, indicative of shining gas—just the kind of spectrum the Galaxy itself might be supposed to give, with its admixture of clouds of stars and gaseous nebulæ, when viewed from a point far out in space.

We owe our present knowledge of these remote nebulæ almost entirely to photography. So faint and feeble are the majority of them, owing to their remoteness, that it needs long exposures with large instruments to reveal their existence, while it is only on the photographic plate that details of the form and structure even of the nearest of them can be satisfactorily studied. But it is possible to arrange these objects in an orderly sequence according to their shape, and this almost certainly indicates the line of their evolutionary development. Some of them appear merely as round masses of haze; others are flattened or roughly bun-shaped; others, again, lens-shaped with a sharp edge round the periphery—just the forms that would be assumed by a mass of gas rotating with increasing speed—but the most striking of all exhibit arms of luminous matter apparently ejected from opposite sides of a central nucleus to form a double spiral. Among the more fully developed nebulæ some display a granular or broken-up structure—especially in the outer portions of their spiral arms—suggestive of the groups and clusters of stars within the Milky Way, and in a few cases separate minute points of light are visible on the photographs which are evidently individual stars.

It has generally been believed that the extra-galactic nebulæ are considerably smaller than our stellar system, but they are at any rate comparable with it. Their average mass has been calculated as roughly equivalent to that of two or three thousand million suns, but recent work suggests that this estimate may have to be increased considerably.

Are we within a Nebula?

And here an interesting question arises: Is our Galaxy itself a spiral nebula? This is just what many astronomers, beginning with Easton, have believed it to be, though its true form, if it be such, is obscured by the fact that we observe it from the inside and from a position not so very far out of its plane. In agreement with this view, J. H. Oort and others have shown that it is rotating round a centre or hub, the direction of which is marked by the dense star-clouds in the Sagittarius region of the sky. The nature of the motion is the same as that in our planetary system, the parts nearer to the centre moving more rapidly than those further off. At the distance of the sun the time required for a revolution is over 200,000,000 years.

What seems to be a further correspondence between the Galaxy and spiral nebulæ has been pointed out quite recently by Shapley in his George Darwin lecture to the Royal Astronomical Society. He has found on plates of the Andromeda nebula region a number of small distant objects, which give the whole system an approximately spherical form, and show it to be very much larger than we have hitherto thought it to be. It is natural to see in these remote outlying objects the counterpart of those wonderful and beautiful conglomerations of stars—the Globular Clusters—which are associated with our own Galaxy.

And now let us consider what we know as to the distances of the nebulæ of which we have been speaking. I mentioned just now the images of individual stars on photographs of some of the spirals. Among these stars are some which flash out brightly at regular intervals—say of a few days—reminding us of the regular flashes from the revolving lantern of a lighthouse. In our own

stellar system stars which behave like this are known as the *Cepheids*—after the typical star, Delta Cephei—and the important thing about them is that a relationship has been established between the length of the interval separating their outbursts and their *real* brightness. The longer the interval the brighter the star. If we can assume the same relationship to hold for the Cepheids in the nebulæ, then a comparison between what we know must be their *real* brightness with their brightness *as seen by us* will enable us to determine at once their distance, and hence the distance of the nebula in which they are situated. Observations of Novæ, or "new" stars in the nebulæ, which we may assume to be similar in brightness to those which blaze out from time to time in our own system, are also utilised, and give accordant results. On the further assumption that the nebulæ in general are roughly comparable in size, the distances of other and more remote objects can be found from their measured dimensions. To give some of the latest conclusions drawn from such material—it seems that the nearest of the nebulæ—for example, those in Andromeda (M. 31) and the Triangle (M. 33)—are at a distance of nearly a million light years—a *light year* being the distance travelled by light in a year, which is very nearly six billion (6×10^{12}) miles. The remotest hitherto recorded are apparently at distances approaching 150 million light years, but when the 200-inch reflecting telescope, of which we have read so much, is completed, the length of our sounding line will extend to a distance of nearly 300 million light years.

Receding Limits of the Universe.

There is a startling fact which we must now notice. It is that the extra-galactic nebulæ are, on the whole, rushing away from us at great speeds, and the more distant they are the more rapid in general their retreat. The observed fact leading to this conclusion is the measured displacement of the lines in their spectra towards the red end. If the assumed interpretation of their displacement is right, the effect is exactly analogous to the drop in the pitch of the note emitted by the whistle of an engine as it rushes past the platform on which we are standing. When approaching us the note is higher, when receding lower, than would be the case were the engine stationary relatively to ourselves, and by the difference of pitch the rate of motion can be calculated. But the deduced recessional velocities of the nebulæ are enormous, and in the cases of those which are most remote they actually reach thousands of miles per second! This means that the known Universe is rapidly expanding; in fact, at its present rate it appears to be doubling its radius in about thirteen or fourteen hundred million years.

We need not trouble ourselves much with the debated question as to the exact interpretation of this remarkable conclusion. According to Einstein's original theory space possesses the property of "curvature," so that, though unbounded—nowhere are we brought to a stop, we can always go on—it nevertheless has a finite radius, like the curved surface of a sphere. The expansion of the Universe can then be compared with the expansion of a bladder which is being blown up, and on which from any point on its surface all other points are moving away at a rate proportional to their distance. This simile can, of course, only serve as a partial illustration, since the surface of the bladder which represents space is two-dimensional only, and we are left to imagine curvature in the third dimension as best we can.

A Good Word for Euclid.

On the other hand, there are those who question whether a general curvature of space is or is not a feature of the Universe taken as a whole, whatever may be true of local gravitational fields. It is held that our present knowledge is insufficient to justify us in speaking positively on this point, and that space may turn out to be Euclidean after all! In particular, Professor E. A. Milne believes that this is so, and has developed a new theory on this basis. There seems, however, to be little room for doubt that the scattering of the nebulæ which I have mentioned is a fact, and we note that as shown by the Abbé Lemaitre such an expansion in a relativistic universe is to be expected on theoretical grounds. On this view the Universe is now well on its way from the state of static density originally supposed by Einstein to the Universe of practical emptiness described some years ago by de Sitter.

Let us now turn to some other features of our modern outlook on the Universe. The last century saw the establishment of the doctrine of Evolution. That doctrine has had, as all new doctrines must, its modifications and amendments, and not least has this been the case in astronomy. The particular mechanism of Laplace's famous Nebular Hypothesis, when studied quantitatively, has been found quite inadequate to account for the genesis of our planetary system to which he applied it, though it may well describe, as pointed out by Sir James Jeans, the processes in development of the large extra-galactic nebulæ, when once gravitational instability has broken up the primordial cloud of diffused matter into regions of local condensation.

But there are other respects in which recent ideas concerning evolution are less assured than those commonly held in the last century. The views then taken may be summed up in Herbert Spencer's doctrine that

the order of development is from the simple to the complex, or " from an indefinite, unstable homogeneity to a definite stable heterogeneity." This does not, however, appear to represent accurately the facts as known to-day. The movement of cosmical evolution can hardly be compared to the movement of the traffic in a one-way street, for there are opposite processes in operation simultaneously. There is, for example, so far as we can tell, the building up of suns out of the diffused matter in the great nebulæ ; there is probably, too, the combination of atoms of the simplest element, hydrogen, to form atoms of heavier elements ; but as a set-off against this there is the breaking down of heavy atoms in radioactive substances indicating that disintegration as well as synthesis has its place in cosmic physics. And then there is the great expenditure of energy in radiation, which is gradually bringing about a wholesale change in the condition of the Universe. Think for a moment of our sun, which is just one of countless millions more or less like it. For immeasurable ages has it poured forth its streams of light and heat into space, and let us remember that its total output is some two thousand million times that fraction which is intercepted by the Earth ! How is this display of energy to be accounted for ? How can it be maintained ? Some of the energy manifested in the Universe may be that released in the building up of other atoms out of hydrogen ; some is set free by the disintegration of atoms in radioactivity ; some results from the contraction of the diameters of stars following the loss of heat by radiation in accordance with Lane's Law, but the most interesting theory is that put forward by Sir James Jeans several years ago—viz., that the main supply is generated by the actual annihilation of stellar atoms as such through the neutralising of the positive and negative charges of protons and electrons, or, in other words, by the conversion of matter into the energy of radiation. Our sun is known to be actually radiating away at the present time 4,000,000 tons of its mass per second, and, whatever the precise mechanism may be, it is obvious that this kind of expenditure cannot go on indefinitely. The Universe as we know it now must be running down !

Uniformity is Death.

This brings us to the Second Law of Thermodynamics, of which we have been hearing and reading so much. Put quite shortly, the principal embodied in it is that wherever work is done something is lost—some energy is squandered and ceases to be available for any useful purpose. In other words, although the law of the Conservation of Energy may still hold good taking the Universe as a whole, the ratio of available to unavailable energy is gradually diminishing, or—as it is commonly expressed—entropy always increases. And the end of this irreversible process would seem to be the reduction of all the transformable energy of the Universe into uniform undifferentiated radiation. In short, the Universe—since its " life " depends not on the mere presence or possession of energy but on differences and inequalities in its distribution—*i.e.*, on its availability for work—appears to be moving steadily on its way to a state of uniformity which can only be described as " death "—a death which it is asserted must be final—beyond all hope of a revival.

Can the Universe Survive ?

It looks as if, after all, we are not so very wrong, when we take the long view, in comparing the process of cosmical evolution to the traffic in a one-way street—only the movement is in the opposite direction to that which we were once wont to " believe." The idea that the Universe is running down is, of course, by no means a new one, though it has lately been brought into special prominence. I note that in his book " Recent Advances in Astronomy," published in 1898, Dr. Fison—in whose memory this lecture is given—wrote at the end of his chapter on " The Life of a Star " this sentence : " As æon succeeds æon, and as new nebulæ follow those from the ruins of which they were formed into extinction, the Universe becomes poorer in active energy ; and there appears, so far as physical science has interpreted the process of nature, no escape from the picture of an accumulation of inert matter as the last memorial of a glorious Universe of Suns." But the thought of a dying Universe has naturally raised protests. It is true that the end will not be yet awhile. Many billions of years have elapsed since the process of running down began, and it will be many billions of years yet before the night finally settles down upon creation ; but there are those to whom the thought that such an end will ever be is distasteful, and who cherish the hope that after all there may be some means whereby the dissipated energy will be, or perhaps is even now somewhere being gathered, up again, and that the Universe as a whole will never die. The suggestions which have been put forward as to how this might be have not in general proved acceptable to the physicists, but there is one line of argument which seems to merit careful consideration. It is that developed by R. C. Tolman in his Willard Gibbs lecture in December, 1932, at the joint meeting of the American Mathematical Society, the American Physical Society, and Section A of the American Association for the Advancement of Science. Abandoning classical ideas, he examined the principles of thermodynamics as they apply in a relativistic universe. Planck and Einstein

had already considered the subject in relation to the restricted theory of relativity, but Tolman extended it to the gravitational fields of the general theory and to the Universe as a whole. The conclusions at which he arrived are interesting, the most important being that it is possible in relativistic thermodynamics to conceive a Universe in which there are successive expansions and contractions without its ever coming to rest, and without a condition of maximum entropy ever being reached. Tolman himself, however, urges caution in accepting such a theoretical conclusion as representing actual conditions. He remarks on the different types of possible cosmological models, and the inadequacy of our present knowledge to discriminate between them; but at the same time he does warn us against the dogmatic assertion "that the principles of thermodynamics necessarily require a universe created at a finite time in the past and fated for stagnation and death in the future. "Indeed," he continues, "the chief duty and glory of theoretical science is certainly not merely to describe in complicated language those facts that are already known, but to extrapolate—as cautiously and wisely as may be—into regions yet unexplored, but pregnant with human interest."

(To be continued).

American Archæological Research of the Year.

By Stanley Casson.

Interesting work has been carried out by archæological expeditions from the universities of America. In addition to exploring the inexhaustible treasure house of the Near East, they have begun a systematic examination of Ireland. The results described below are distinctly encouraging.

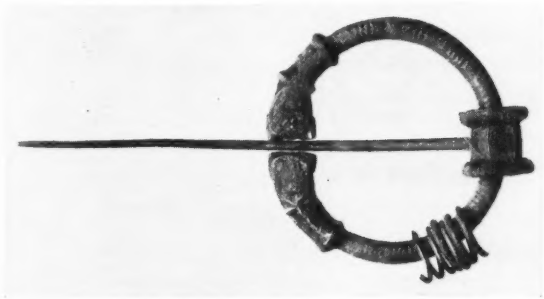
DESPITE financial difficulties American universities and learned institutions are still able to maintain in the field a large number of expeditions which are doing first-class work. The excavations at Dura-Europos on the Syrian Euphrates, at Persepolis in Persia, at Troy and at Athens, and the comprehensive scheme for an archæological and anthropological survey of Ireland organised by Harvard University have all been productive of results of the very highest importance. The excavations at Athens and at Persepolis have added a wealth of historical and artistic material for the use of scholars. The now famous epigrams commemorating the battle of Marathon, found last year at Athens and the many thousands of Persian inscribed tablets found at Persepolis, will add to literature as well as to ancient history, throwing particular light on the Persian wars in Greece. The latest finds from these sites have already been fully published.

At Troy careful and methodical work is being done. Revision of past conclusions, re-establishment of stratifications, search for new areas to be investigated, and a fresh examination of the whole Trojan chronology must of necessity produce results of the highest value to the Homeric scholar. The latest information from Troy is in some respects surprising. In one of the great towers of the so-called Homeric City was found a group of large stones which appear to have comprised an altar and votive stones of the type well known in the megalithic regions of western Europe. There is no mention of any mode of worship in the Homeric poems which might explain them and we are driven to the conclusion that native Trojan worship and religion was of a type distinct from that prevalent in the Aegean. Much further research will be necessary before it will be possible to give an outline of prehistoric Trojan cults and modes of religion. Sufficient that they appear, at the moment, to be unusual. So far no trace of a necropolis has been found at Troy of a date anterior to the late classical and Roman periods. The discovery of graves of a date before 1000 B.C. is anxiously awaited.

The excavations at Dura-Europos are of particular value since they concern a site not ante-dating the Hellenistic age. The results of the last six years' excavations by a party of scholars from Yale University have been fully published and need no comment here. But in 1932 some of the most important discoveries were made. A Christian chapel, decorated with paintings dating from the 3rd century A.D., was revealed. These are the earliest Christian paintings ever found in the East, and the only Christian mural decorations from Syria dating from the period of the Roman catacombs. The chapel was in fine preservation and the colours of the paintings largely intact. Most of these paintings have now been sent to Yale University Art Galleries. The discovery of this chapel gives a document of inestimable value to historians of art: for in the style of painting illustrated are seen the germs of Byzantine art and the last flowering of Hellenistic styles. The discovery last year of a synagogue with its walls similarly painted with Semitic subjects has added still further to

our knowledge of the development of painting in the Near East. Here were scenes from the Old Testament as conceived by Jewish artists, or at least by artists working to the order of Jews. One of the frescoes depicting the Exodus has been taken to the Yale galleries.

The excavations in Ireland have now been carried on for two years and a third season is now in progress. Thus for the first time properly controlled scientific researches are being carried out on Irish soil on a large scale. The discoveries last year were of the greatest interest. A marsh-stronghold in County Offaly was the most important site to be investigated. Here was an artificial island made in a bog and first settled in the early years of the Christian era. Slowly the settlement grew and developed passing through all the phases of early Irish history of the Heroic Age. Homeric in its mode of life and in its simplicity and roughness, the settlement showed signs of culture and art. A superb bronze brooch of the 7th century A.D. was found, decorated with inlaid glass mosaic of the characteristic Irish type. One of the finest ornaments of its kind ever discovered in Ireland, it is of great size and weight, being nearly eight inches in length, with the circular portion some five inches in diameter. The settlement contained a large rectangular house some fifty feet square on a foundation of massive oak beams. The walls were apparently of wicker and the roof of thatch. A smaller house and a number of rough huts made up the rest of the settlement. The occupants were at all times herdsmen and farmers and their life fell into the period recorded in the sagas of the Ulster cycle and the songs of Deirdre. Soon after A.D. 100 the island and its buildings were largely reconstructed. A splendid speci-

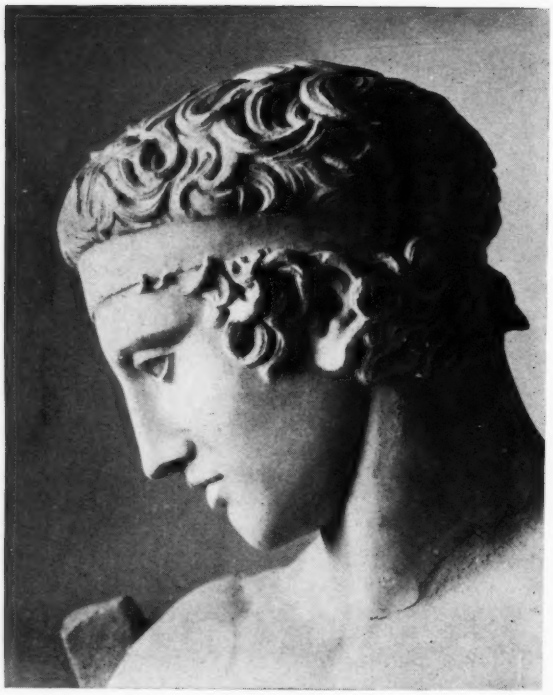


The penannular design of this brooch is common in Irish art; but the size and weight are unusual.

men of a dug-out boat, a six-oared craft hollowed out of an immense oak, was found in the level of this new period of reconstruction. Oars belonging to it or to smaller craft were also found. Imported Roman

Though found in Central Ireland, this game-board betrays Celto-Norse influences in the border pattern.

pottery and locally made bronze vessels showed how the insignificant settlement gradually came into contact with external culture and local art. Bronze mountings of a drinking horn and a large bronze hanging bowl also came to light. Amber beads and imported glass and lignite ornaments were found. The settlement was abandoned in the Viking period, but before its end the proximity of Norsemen was made clear by the discovery of a remarkable, indeed, unique, gaming board of yew wood, decorated in a manner which shows that it was an importation from the Isle of Man when artistic development in that island was of a Celtic character dominated by Viking and Norse influence. It probably reached the settlement by way of the Danes of Limerick about A.D. 973-977 when the Isle of Man was under Danish domination. The decorated border of the gaming board resembles borders on Manx sculpture of this period. Among Vikings as well as Celts board-games of this type are widely known; it is in any case interesting to get such specific light on the pastimes of the Irish inhabitants of this remote stronghold.



The Diadumenos head recently acquired by the New York Metropolitan Museum.

No less active have been the authorities of the American Museums in securing new acquisitions. Financial embarrassment has affected only the smaller and less well-endowed institutions. In 1933 the Metropolitan Museum in New York bought a group of fragments of a splendid copy of the famous Diadumenos of Polycleitos. The fragments comprised the two arms, the legs from the knees, and the head and neck. Oddly enough the essential parts of the statue had survived, whereas it is usually only the torso that escapes. The surface condition and finish of the copy—which is of the 1st or 2nd century A.D.—are excellent and it can rank as one of the finest, if not the finest copy extant of this famous work of Polycleitos, the 5th century Greek master. Its only rival is the copy found at Delos, now in the National Museum at Athens. A cast of the Delian copy has been used for the purpose of providing a body for these substantial fragments and it was found that the fragments harmonised very closely with the Delian version. As it stands in the Museum at New York the Delian torso shows off the fine head and arms of the new copy to perfection. A small copy in terracotta of the same statue has also recently been acquired by the same museum. This copy has until recently been on exhibition in the Louvre in Paris.

Progress at Tell Duweir.

THE Wellcome Archæological Research Expedition to the Near East is looking forward to a profitable season's excavation in 1934-35. It is hoped that further fragments may be found of the pottery ewer with the valuable Canaanitish inscription, though it is perhaps too much to expect that the missing letters of the inscription itself will turn up. In Mr. E. N. Fallaize's article in *Discovery* for August, 1934, the inscription alone was illustrated; this month, by courtesy of the Director of the Expedition, Mr. J. L. Starkey, we are able to give a picture of the ewer as so far reconstructed. The interpretation of the writing is not yet definitive, but the Rev. Father Burrows, who was philologist for three seasons with Mr. Leonard Woolley at Ur, has recently made the fullest transliteration. The accompanying table compares Father Burrows's solution with those of other authorities.

The charming little perfume flask, of which a photograph appears on p. 276, was likewise described by Mr. Fallaize in our August number. Apart from its interest as an example of northern, non-Egyptian, craftsmanship, it is a splendid example of another craft altogether: the patient skill used by members of the Expedition in reconstructing shattered treasures. As Sir Flinders Petrie once pointed out in the pages of *Discovery*, hours of sifting dust and rubbish must be endured in order to discover the relics of antiquity; when they are discovered it is not to be expected that

Gardiner	M	T	N	Numeral							ALLATH	aleph or	L	T	
													ELAT		
Gaster	M	T	N	Numeral 3						T	S	D		T	
		GIFT									AN OFFERING				
Langdon	M	T	N	colon	sh							aleph	P	T	
Stawell	M	T	N		S	G						A	L	T	
Eisler	M	T	N		S	G			L	T	G	aleph	L	T	
	AN OFFERING				(A)						redemption				
Burrows	M	T	N	3	S	W	R	M	T	W	aleph		L	T	

Father Burrows's version of the inscription seen on the pottery ewer (opposite) is a new and important step towards its decipherment.

The pottery ewer, repaired as far as possible, showing part of the Canaanitish inscription.

they will be in pristine condition, and further laborious care is needed before they are ready for exhibition.

In our book-review columns a notice of a useful handbook published by the Museums Association, instructing curators and collectors in the care of exhibits after they have been deposited in museums, appears especially appropriate when the enormous care involved in preparing the exhibits is considered.

Correspondence.

SCIENCE AND RELIGION.

To the Editor of DISCOVERY.

Sir,

With reference to Professor Huxley's questionnaire which appeared in this month's number of *Discovery*, my answers to questions 1, 2, 6, 8 and 7*a* are what he would expect from scientifically educated readers.

As regards question 3, I consider the example given very ill-chosen. An educated theist, especially a Christian, would not pray to God for victory in war because the gains and losses of war are evil.

In answer to question 5, I agree that most educated people do not still hold the primitive belief in the Devil. Coldness and heat were once thought to be separate qualities. It is now known that although we may perceive them as such, coldness is merely lack of heat, or lesser molecular vibrations. One, and only one agency is necessary to explain heat and cold. Similarly, evil is lack of goodness or of God and we do not need a Devil to explain it. This does not mean that God is facing from our beliefs but that, if we accept Him and receive His goodness, then, as there is no other agent to oppose Him, He will become all-powerful. I consider that prayer for the Goodness of God can alter the course of human affairs.

Our new conception of God is largely due to the advance of science. Professor Huxley says that God is likely to become a more " shadowy Being " with the future advance of science, yet he finds that the most recent scientific thought is not suitable to his argument. He returns to the old conception of space and time in question 4, when he speaks of " the constant activity of God to maintain the processes of Nature."

I believe that advance in science will change our mystic philosophy but it will not change the theist's essential beliefs in the nature of God. It will give us a fuller understanding and a better chance to use His goodness.

Yours faithfully,

MARION E. HAMLYN.

London, S.E.14.
11th September, 1934.

To the Editor of DISCOVERY.

Sir,

In the theological controversy, it is a fact that God is only invoked with reference to something which contemporary human knowledge finds itself unable to cope with thoroughly. It also is a fact that all scientific work, theoretical and practical, proceeds utterly without reference to God.

If then the scientist is convinced that the word " God " is without meaning (for him) why should we object to his writing with this implication ? If his writings are at variance with his convictions he is dishonest.

Regarding the theistical scientist, we must remember that many of these, like Faraday, deliberately avoided application of the principles of reason to their religious beliefs, keeping these in " watertight " compartments.

Personally, I do not think any great furore would arise if editorial endorsement were given to Professor Huxley's views. The atheistic readers of a cultural periodical are not to be counted in ones or twos.

As the word " God " means a personality of some sort, and as I can find no room in our knowledge of the cosmos for such a personality, I am driven to the conclusion that it does not exist, and that I must refer to myself, and others who think similarly, as atheists.

One correspondent declares that " science deals with physical phenomena only," as if some phenomena were not physical. Actually science deals with *all* phenomena without exception, and it finds that all explainable phenomena can be referred to the realm of physics. It also finds that the unexplainable happenings are potentially explainable by physical means, present inability being obviously due to imperfect knowledge.

In conclusion may I respond to your invitation to submit answers to Professor Huxley's queries.

1. No; 2. No; 3. No; 4. No; 5*a*. Yes, 5*b* No; 6. No; 7*a* Yes, 7*b*. Nothing; 8. No; 9. They can be explained by ordinary psychology.

Yours faithfully,

Liverpool. J. C. ANDERSON.
September, 1934.

MATHEMATICS AND THE BIOLOGICAL SCIENCES.

To the Editor of DISCOVERY.

Sir,

Since the study of the development of living organisms has produced a considerable harvest of data, it seems desirable that this should now be searched systematically for instances limiting the application of mathematical analysis. For the recorded history of this evolution and even that of trends in its development is frequently discernible as tending towards minimal forms, and it has proceeded under conditions which are in many respects well understood.

Were collaboration of mathematician and biologist undertaken, it would bring powerful mathematical aid to the latter and it might also contribute to the development of mathematics itself.

It is hard to believe that workers in the biological sciences are well informed on those more powerful mathematical methods which have been developed and applied in other sciences, notably in physics, modern chemistry, astronomy, etc.

One does find, it is true, a treatment of a metrical and statistical character in modern writings on biological science, but rarely does it appear that the writer has a working acquaintance with the more penetrating methods of mathematical analysis. The inherent complexities of biological processes and the difficulty of discerning them with clearness must, it seems, have discouraged that approach from the mathematical side, which the circumstances of physics, etc., so often invited. And this may be the reason why the former sciences so rarely produce or attract mathematicians of first-rate attainments. However, it is difficult to imagine that biological processes are not ultimately mathematical; and if this be admitted, it is surely pertinent to ask whether the sciences that have been developed in the study of living matter are to remain content to use verbal methods of description or, on the other hand, to turn more and more to the suggestive and fertile forms of expression found in analysis?

The collaboration of mathematician and biologist, suggested above, could take place probably most effectively and conveniently within a university.

It might well be that mathematics would gain from this co-operation as much as the other; for it seems that the former is in need of a new foster parent, since the suggestion and guidance which it has hitherto received without stint from the natural (inanimate) world are not now so much in evidence. If this half of nature has been so prolific in suggestion for the mathematician it is hardly believable that the other (animate) half, which he has hardly yet entered, can have nothing new to teach him.

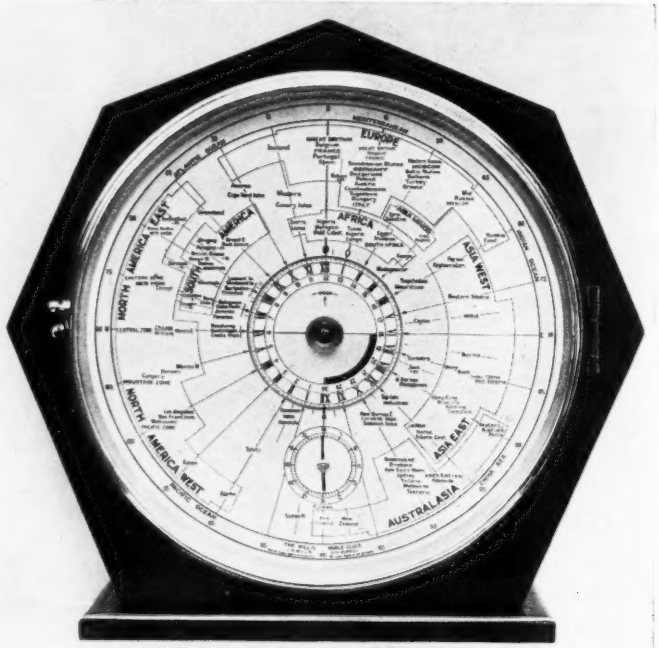
Yours faithfully,

12, Devonshire Square, E.C.2. T. W. MACALPINE
27th August, 1934.

A New World Clock

By R. R. Bales.

A CLOCK invented by a Norwich man, Mr. J. H. Willis, may affect our existing way of telling the time. The new clock shows the exact time everywhere at a glance, and indicates at what moment any world broadcast or S.O.S. call anywhere despatched reaches other points. Until now, these results have been achieved only by means of a clock using hundreds of hands; but in the new design, instead of the hands revolving round a stationary dial, the dial itself revolves anti-clockwise.



One o'clock by Greenwich Summer Time.

The identical effect is obtained, only this time more simply. The dial always shows the hour at the stationary point representing any given time-area, and any number of fixed points may be marked.

The mechanism is simple, since the dial can be made to revolve merely by friction drive from a spring drum, and as the clock can be read at different meridians, it never needs to be altered on account of the shift to "Summer Time," but shows the correct and relative times universally.

The stationary *emphasised* pointer—or, during the period of Summer Time, the *skeleton* pointer—always shows the hour at one's own meridian, as is clearly seen in the photograph. The hand on the other revolving dial below shows the minutes past the hour.

Strange Fish of the Red Sea.

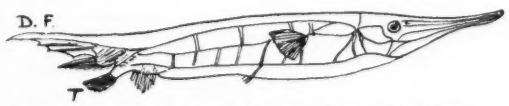
By Cyril Crossland.

Director of the Ghardaqa Marine Biological Station.

The University of Egypt has built and equipped a Marine Biological Station on the Red Sea, thus providing an opportunity for seeing the coral reefs and tropical fauna which have hitherto been accessible only with difficulty. Naturalists owe a debt of gratitude to the University for the facilities thus provided for tropical marine research.

THE University of Egypt has established a Biological Station on the Red Sea at Ghardaqa (or, as Europeans call it, Hurghada), a little south of the entrance to the Gulf of Suez and due west of the island of Shadwan. The Director, on application, will arrange for the transport of visitors from Suez by the steamer of the Anglo-Egyptian Oilfields, whose camp adjoins the Station and provides bungalow accommodation. The steamers run twice weekly and occupy about 24 hours in the passage. Visitors from Luxor and the South may take the train to Qena, whence a motor car will convey them across the Desert and the Red Sea Mountains in six hours. Early summer and autumn are the best seasons for a visit, though even in the height of summer the climate is rarely trying.

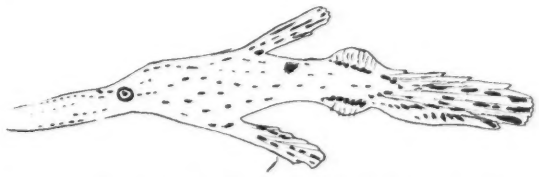
The remarkable clarity of the water obviates the necessity for a show-aquarium; much more can be seen by looking over the side of the boat than the best-stocked aquarium could show. Interesting marine fauna are present in great quantities; for instance, a few hauls of a small trawl, on the "grassy" sea bottom just off the end of the Station jetty, will give about thirty species of small fish, among which are several of highly abnormal structure and habits. The well-known "sea horse" (*Hippocampus hystrix*), and with it the "pipe fish," come up in nearly every haul. The "sea horses," including the rare *H. guttulatus*, do not look like fishes at all but for their having fins; even so, the tail fin is lost. The tail itself, being of no use for swimming, can support the animal by twisting round blades of the "sea grass" among which it lives. The "pipe fish," on the other hand, in spite of their worm-shaped, heavily scaled bodies, are recognisable as being fish. One of them (*Gastrotokeus*) has a prehensile tail



Amphisile scutata (*or a local variety*), *with tail overshadowed by the huge dorsal fin.*

without a fin upon it, thus making a clear link between pipe fish and sea horses. All of them are coloured to one in with seaweeds, and carry spots of dull red and brown on their greenish bodies resembling the growths and spots of decay common on the grassy weeds among which they live.

This protective colouring is carried so far in a species of *Solenostomus* that the fish, though about three inches long, is so difficult to find among the "grass" and weed brought up by the trawl that it may not actually be the rarity it seems to be. The drawing shows the bizarre shape which would seem to make it conspicuous enough, but in life its flat, leaf-like form and brilliant green colour, its large flat pectoral fins, and even the black marks so conspicuous in a specimen preserved in alcohol,



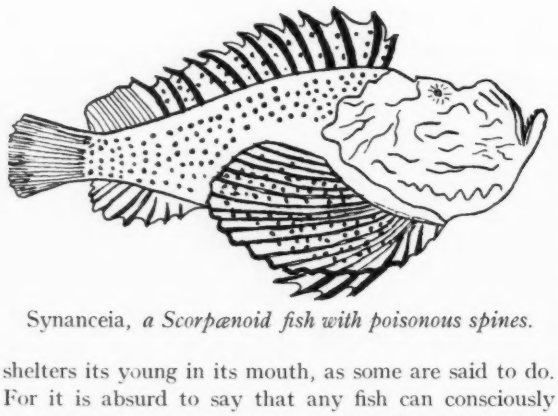
Solenostomus, *a local species not yet named, practically invisible among grassy weed.*

all combine to make it almost invisible even among trawled grasses, and still more so in natural conditions.

Another totally unrelated fish (*Amphisile scutata*) also has the tubular suctorial mouth characteristic of the above. As the drawing shows, the body is covered with huge scales, which are so fixed together that the fish is quite stiff, and so extraordinarily flattened that it resembles a knife blade as much as anything. Note the deformity of the tail, which is not at the end of the animal, but beneath. The tiny fins would seem to indicate slow motion, but how this queer thing lives I cannot say, since, in spite of its being armed, in proportion to size, more heavily than the crocodile, it is always dead, or nearly so, on arrival at the surface. Presumably all these fishes use their pipe-like mouths to suck in little water fleas, as described by Boulenger in the *Aquarium Book*.

The pipe fish is one of those rare cases, among fishes, in which the eggs are given shelter until they hatch, and the young until they are able to take care of themselves. It is the male alone that undertakes this parental responsibility, for the female, after fixing the

eggs to a pouch on the ventral side of the male, swims care-free away. Another fish caught here (one of ordinary shape) carries the developing eggs in its mouth, like the *Tilapia* of the Nile. With this great bulging mass of eggs to carry it is obvious that feeding is impossible ; the wonder is that it can breathe. Ordinarily big fish eat little fish, whether of their own species or not, so here we have the development of an instinct as utterly opposed to the normal as when a large shark



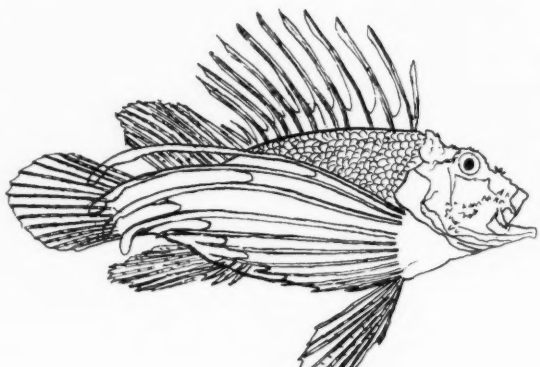
Synanceia, *a Scorpænoid fish with poisonous spines.*

shelters its young in its mouth, as some are said to do. For it is absurd to say that any fish can consciously recognise its own young ; the rudimentary intelligence sufficient for this did not appear in the world for many millions of years after the fish had attained all the brain development of which their type is capable.

The Scorpænoids are ugly things with a sharp spine wherever a spine can be developed. All are unpleasant to handle and some are actually dangerous to life, the spines being provided with poison glands. The little ones we get in the trawl are among the less specialised of the family, and can be handled with care, but from these development takes two directions, one leading to forms so wrinkled, pitted and swollen as to be the most ugly of living things, beside which a crocodile is a nice, clean, healthy creature, and, by most accounts, also much safer to run up against. For these Scorpænoids so closely resemble dead and pitted pieces of old coral, covered with weed slime, as to be practically invisible in their natural surroundings, and to tread upon one barefoot, or even with thin shoes, means agony, possibly death. Luckily they are not common, though two species have been found here. One saving grace is that if they can they will escape accident to themselves or to the wading fisherman, and as they flutter away the sudden appearance of bright yellow under the fins or, in one species, of clear white bands on the tail, acts as a warning against pursuit.

Evolution in another direction leads to *Pterois cincta* (Rüppell), in which a clean fishlike body bears a wrinkled and frilled Scorpænoid head, while the fin and dorsal rays are extraordinarily prolonged, like feathers. The body is striped brown and grey, the " wings " and great crest of " feathers " along the back conspicuously red-brown and white. So far from seeking concealment, as its relatives do so successfully, it fears no foe and is vividly conspicuous. It is quite common here and is known to Europeans as the " chicken fish," from its resemblance to a half-plucked fowl. There is a certain pinnacle of dead coral in the harbour which I visit to admire the soft corals with which it is covered and to watch the sea stars leave their holes and spread their plumes at sunset. At the same time a *Pterois* comes from its hole in a reef a few yards away, swimming slowly. On arrival at this rock, down goes its head, the great " wings " spread horizontally, while the tail is kept vertical. This, like the posterior dorsal and anal fins, is so delicate and transparent as to be almost invisible in the water. In this position the fish stays, motionless but for slow vibrations of the tail, and, though I have often watched it till dark, its object remains a mystery to me.

Naturalists who visit Ghardaqa, however familiar with Mediterranean fauna, are astonished at the brilliant colour of the Red Sea fishes and may regard the illustrations published by Rüppell as somewhat crude approximations, the best that printers could do in 1829. This is not so ; there is no exaggeration of the brilliance of the natural colours—in fact, most of the pictures are



Pterois cincta (*Rüppell*), *conspicuous in colour with feather-like fins and dorsal rays.*

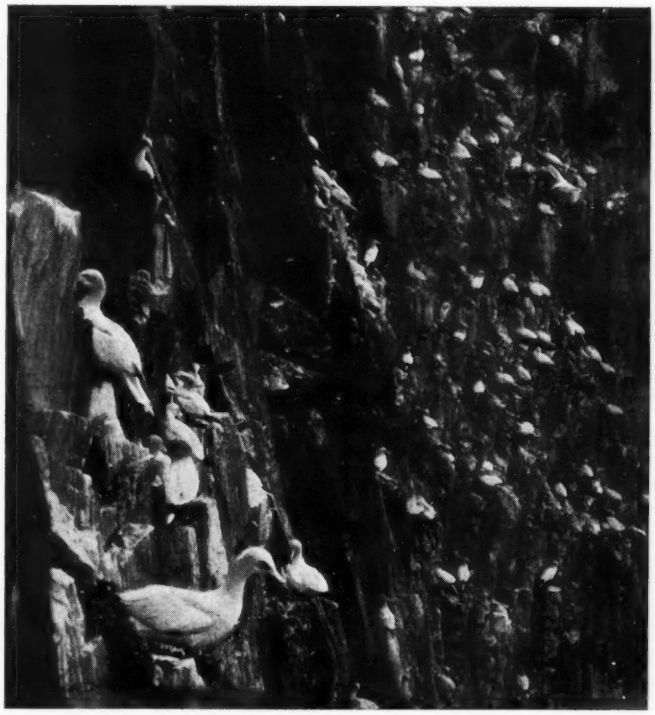
as accurate as they could be made by modern methods. Scarlet, green, blue, and yellow may occur in clear-cut lines and patches, or equally bright colours may mingle in delicate shadings. Other fish, scarlet all over, have a silvery sheen which gives the living fish a beauty which no dead one has, however brilliant its hues.

The Future of British Birds.

By Eric Hardy, F.Z.S.

Lovers of the British countryside will be relieved to read that alarmist reports as to the extinction of wild birds are largely unfounded, and that for only a few species is the stress of modern life intolerable. A timely warning against indiscriminate protection in "sanctuaries" is likewise of great significance.

THE recent addition of six new birds to the British list—the Hebridean Hedge-Sparrow (*Prunella modularis hebridium*), Hebridean Stonechat (*Saxicola torquata theresæ*), Hebridean Twite (*Æanthis flavirostris bensonorum*), the Scandinavian Jackdaw (*Corvus monedula monedula*), Arctic Ringed Plover (*Charadrius hiaticula tundræ*) and the Bridled or Lesser Sooty Tern (*Sterna anæthetus*)—by the council of the British Ornithologists' Union, reminds us that of some hundred new types and records added to our avian fauna during the present century, new racial sub-species have formed a very large proportion, and the future of British birds will no doubt see a further differentiation of new sub-species to be added to our lists. It is not true, as some propagandists suggest, that bird-life in this country is decreasing and that the future of British bird life is one of depleted numbers, for though many species like the kite, barn-owl, avocet, dotterel, Sandwich tern, and puffin are growing scarcer, many more, such as thrushes, gannets, gulls, titmice, buzzards, starlings, grebes, rooks, tawny owls, and fulmar petrels are increasing more than enough to rectify the loss in bird numbers. Nature's sanctuaries have proved a gilt-edged security against the future for many of our birds, particularly the terns, bitterns, and harriers, and provided that the sanctuaries are organised by ornithologists who will regulate the bird life where there is need (for many a good ternery has been ruined by increasing gulls, and injudicious protection of sparrows, and coots and moorhens, on town or marshland sanctuaries, has ruined the sanctuaries there for scarcer birds), the probable further increase in sanctuaries is bound to be helpful.



Gannets on the Bass Rock. Though driven perhaps by tourist traffic from Lundy, this bird is on the increase in remoter haunts.

The vast increase in suburban areas has, on the whole, found bird life adaptable to the new conditions, and censuses carried out by the Oxford Bird Census in the summer of 1932 showed that an area which had, on an average, 5½ birds per acre when it was farm land, had almost 22 birds when it became suburban. On 11 acres in the New Forest, near Ringwood, Dr. Longstaff found 30 nests; six of the acres were arable, the other five copses in which most of the timber had been felled, while the area surrounding was moorland. A house was built, the arable land was converted into garden and orchard, and the copses were replanted and then thinned. In 1925, 120 nests were counted in the same 11 acres.

The writer has amply proved in censuses and observations at the Liverpool Cathedral Wild Birds' Sanctuary in the heart of a city slum eight miles from open country, that, so long as suitable food, water, and shelter are provided, cities are not detrimental to large numbers of our birds. It may be that the birds are becoming more adapted to city life, but at any rate in recent years

buzzard, woodcock, snipe, willow-warbler, goldcrest, ruff, greenshank, peregrine, and wheatear have become regular visitors to Liverpool on passage.

"Extinct" birds that still survive.

Some of the British birds called "extinct" have not even yet become extinct; still less were they extinct at the time of the announcement. It is usually claimed the last ruffs to nest in Britain nested in Norfolk in 1908, but eggs were taken at Martin's Mere, Lancashire, in 1910. There is at least one place off the Scottish coast where the sea-eagle has nested in recent years, while a few years ago the osprey nested in an old haunt in Scotland, though the record was kept a good secret. There is a nesting haunt of the honey-buzzard on the Shropshire-Wales border, and though in many quarters writers have claimed that only two or three kites nest in Wales now, there were eight pairs of kites nesting in Wales (chiefly Breconshire) in 1933, and 107 young kites have been reared in the past thirty years. The policy of awarding £10 to the farmer upon whose land the kites successfully rear their young is a bad one that has aroused jealousy and induced the shooting of the birds. The kites suffer from lack of fresh blood, for some of the females are too old to carry on the full breeding responsibilities, and in-breeding is causing much trouble. The great increase among carrion-crows in Wales, probably largely through a decrease in gamekeepers, is another handicap. On present indications there should be some slight increase in Welsh kites in the next few years.

National and local censuses have already shown that many of our birds will be more or less numerous in the future, but many species not yet covered by census are changing their numbers at much the same rate. The increase of the ducks in recent years has been one of the most remarkable features of our inland waters and estuaries. The tufted duck has probably increased the most. Its first recorded nesting in Cheshire was in 1908, and at Liverpool it has nested since 1930, yet it is now a very common nester in both districts. There has also been a marked increase among the shelducks on the coastal sandhills of the north-west, of shovellers on the marshlands and, to a lesser degree, of gadwall, pintail, garganey, pochard and other rarer nesters, and in the last few years the golden-eye has nested in Cheshire and Yorkshire. Smews now visit the Mersey estuary every winter. Harrison and Hollom, in their 1928 census on the great crested grebe, showed that since 1880 these inland divers had increased markedly and now colonise some 500 waters to the extent of some 1,200 nesting pairs in England and Wales alone, while the increase was spread over the Continent from Norway to France. Similarly one has noticed greater numbers of the little grebe or dabchick, while there has been a marked increase in the nesting of the black-necked grebes in Britain and Ireland. In 1904 the black-necked grebe was found nesting in Wales, in 1915 in Western Ireland, in 1918 at Tring, and in 1930 in Scotland. As many as 250 pairs of this once rare species have been counted on a single lough in Western Ireland. The changed conditions of the countryside are probably the principal factors in this increase or decrease. The replacing of the old home-stable, dove-cote, and barn by the modern garage saw a decline in facilities for the barn-owls, though the more adaptable tawny owls continue to increase. The 1932 barn-owl census of England and Wales showed the species declining at the rate of some thousand birds a year. The progress of the alien little owl is gradual. It is now abundant in East Cheshire and parts of South Yorkshire, but not yet has it colonised Lancashire, the Wirral peninsula of Cheshire, or much of North Wales, and whether the little owl or the tawny owl will be the commonest owl of the future has yet to be decided.

Starlings are increasing remarkably on low-lying arable lands, and though the balance of diet is at present beneficial to man, it may not always be so. Marple's starling census of England and Wales in 1932 showed most of the roosts to be on low-lying agricultural lands not more than 600 feet above sea level. The habit of the native starling of usurping the nest-hole of the green woodpecker has often been described, but it is unlikely to have any marked effect on the numbers of woodpeckers, for the same habit obtains amongst the woodpeckers themselves, and greater spotted woodpeckers sometimes drive lesser spotted woodpeckers from nest-holes the latter have excavated. The green woodpecker has always been the scarcest of the three in the North, but there has been a slight increase in its numbers in the last three years, probably a winter movement bringing more birds into the area.

Public Enemy No. 1.

The increase of the seagulls, however, endangers other birds owing to the gulls' pugnacious habits, and the protection afforded black-headed and lesser black-backed gulls has led to an enormous increase in these birds and a corresponding decrease among terns, whose eggs and chicks the black-headed and herring-gulls filch. In Lancashire and County Mayo, Sandwich tern colonies have been annihilated completely by the ravages of the gulls, and in North Lancashire the increase of the lesser black-backed gull, despite attempts to discourage it by destroying its eggs, has caused much damage to other bird life. Many other birds of our coasts seem to be increasing and will be much more

Black-headed gulls in winter plumage in Kensington gardens.

The grey phalarope has little fear of the camera.

The song-thrush flourishes in suburban conditions.

familiar sights in the future. More numerous visits of the black tern on passage to our inland waters, including as many as forty in one flock on Marbury Mere, Cheshire, in 1930, suggest an increase in this species too, but it may be that older recorders were less observant or less numerous than the recorders of to-day. Grey phalaropes are now annual winter visitors to the north-west coast, and last winter there was a mild invasion of this pretty pearly-grey and silver arctic plover, when some twenty odd specimens were recorded. They are not at all shy of human approach, and members of the Liverpool Naturalists' Field Club photographed birds on the marine lake at West Kirby, Cheshire, from a distance of six feet. Other shore birds like the black-tailed and bar-tailed godwits, curlew-sandpipers, green sandpipers, and purple sandpipers are seen on migration every year (as many as 200-300 bar-tailed godwits in a flock in Lancashire), though, according to observers a generation ago, their passage was so occasional as to justify recording each individual visitor. Each year the ruff visits the sewage farms at Liverpool, the Norfolk coast, and other parts of the country, on passage to or from Finland, while the white wagtail and the Greenland wheatear, once reckoned uncommon migrants, are noted every spring in the West, passing north, usually about a fortnight or so later than the common wheatears and pied wagtails. Temminck's Stint, which is working its way southward in Scandinavia, nested in Scotland in 1934.

The increase in the planting of pinewoods in the country will bring about a marked effect on the bird life of the future. Certainly many nesting places of curlew-sandpipers have been lost in the Breckland through pine planting, but there has been a marked increase in turtle-doves, goldcrests, crossbills, nightjars, and long-eared owls through this planting. Probably the west coastal dunes of Lancashire from Formby to Southport show this change in bird life more than any other place. The first turtle-dove in West Lancashire was noted only just before the war and the first nest just after it, but now this bird nests abundantly throughout the pine-woods.

The hawfinch was usually considered by older historians as one of our rarer English finches, but I have seen it more often in recent years. My report of an increase in their numbers has been questioned, but I surmise that the apparent increase may be due to the depletion of our large woods and the breaking up of so many estates that afforded sanctuary and privacy to these shy birds. There is no doubt, though, that the tree-sparrow is spreading its range. It is very much more numerous in Cheshire and North Wales, and it has been found by experiment in Cheshire to increase remarkably over an area when small-holed nesting-boxes are erected along the hedgerows. The bullfinch and goldfinch seem to have decreased much in recent years, probably through the ease with which they are caught for caging, though the gaudy chaffinch, equally popular in the cage, and the greenfinch have in no way decreased. The large winter "charms" of goldfinches are a less frequent sight now than formerly, nor do we hear the shrill "*pee-pee-pee*" of the wryneck on the tree-trunk in spring or the "*yu-tick*" of the whinchat in the meadows nearly so frequently as a generation ago. The cause of the decrease among redstarts is so

The eider duck is increasing, like most other ducks. A photograph from the Farne Islands.

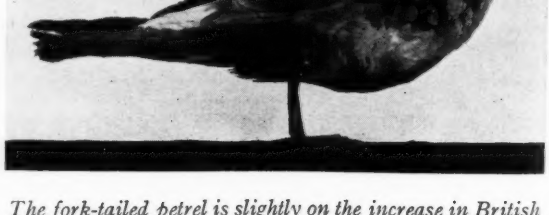
far undiscovered, but that of the corncrakes is usually attributed to earlier and closer-cut harvests, for where harvesting is later, or on the hill-sides, or where cutting is still done with a scythe, these rails are the more numerous.

The increase of the wood-pigeon in recent years, particularly the numbers of the greyer Continental birds that migrate to Britain in winter, is causing much concern in agricultural circles, and many extensive wood-pigeon shoots have been organised in recent winters. The trouble concerning the increase of the wood-pigeon and the starling is that it lies mainly in their Continental nesting quarters, and shooting them when they visit us in winter helps but little in reducing their numbers so long as they are uncontrolled on the Continent.

I do not think the hoopoe, brambling, redwing, or golden oriole are any more or less numerous than a generation ago, despite recent records of their nesting, for quite as reliable records were made of the nestings of these birds a generation ago. There is, incidentally, a growing tendency amongst natural history officials to discard as unreliable all old records with which they are not familiar, and to substitute modern ones, often of their own making and seldom any more trustworthy. This habit is to be deplored, for many an author of a bird-list kept his notes brief to save space and money, and lack of details alone does not justify the denunciation of a record.

Game birds are not usually studied in detail by those who are concerned with wild birds, but it should be mentioned that since the passing of the Game Act of Great Britain in 1831, partridges have increased over 200 per cent. and pheasants over 1,000 per cent., while in the six years from 1919 to 1925 British game birds, depleted through war-time economies, were increased by 900 per cent. Nicholson's 1928 census of the herons of England and Wales revealed 20,000 birds in 280 heronries, but the birds are decreasing. Though the anglers' prejudice against the heron as a fish-eater has largely been removed, many county councils follow Lancashire in persistently excluding it from the scheduled bird-list under the Wild Birds' Protection Acts, though others, like Cheshire, with more herons than their neighbours, afford it complete protection.

The increase of the skuas and the petrels is extremely interesting. Many precautions were taken to save the great skuas' nesting haunt on Unst, even to the awarding of a gold medal by the London Zoological Society to its friends, but such has been the increase that other bird life has suffered and control has had to be applied. The nesting of the fulmar petrel has not endangered other birds, but the increase is probably more impressive than of any other British bird. From Foula and St. Kilda, once the fulmar's sole nesting haunts in the North of Britain, the species has spread down the Scottish coasts and the west Irish coast, and increased its visits to the west and north-east of England, so that it is most likely the future will see the fulmar nesting in increasing numbers. There has also been a slight increase in the numbers of stormy petrels on the lonely Skerries off the west of Ireland. Only two nesting places of the stormy petrel in Ireland were recorded until recently, but off the Mayo coast they now nest on Inishark, Davillaun, Inishkeeragh and Big Island. The gannet also has increased impressively on the Little Skellig off the Kerry coast, on the Bass Rock, Ailsa Craig, and the Northern Isles of Scotland, and especially on Grassholm, beyond St. David's Head. Most of the colonies are now so crowded that guillemots and razorbills have been driven away in numbers to seek quarters elsewhere. Puffins and shearwaters on the coast are decreasing through the increased competition of more vigorous birds for



The fork-tailed petrel is slightly on the increase in British nesting haunts.

nesting sites, and especially by the depredations of the black-backed gulls. The disappearance of the Kentish plover is one of the greatest losses due to the spread of "bungalowdom." It is doubtful whether the Kentish plover still nests in Britain. Dungeness shingle was thought to be its last nesting place, but the Liverpool ornithologist, Mr. R. B. Burrowes, who at his own expense and sacrifice bought up a vast stretch of Dungeness in 1930 to save it from the bungalow builders, tells me he failed to locate any nest last season, though the birds were seen to arrive. The failure at Dungeness is due to the failure of the help that Mr. Burrowes so urgently needed, for the preservation of the spaciousness of Dungeness was essential to the nesting of the Kentish plover. There are nesting places still remaining on the Continent, and perhaps the lesson of Dungeness and the need of quick and united action will be observed before it is too late.

A great danger to the future of British bird life is the lack of co-ordination amongst bird-lovers in this country as compared with North America and Germany; we have too many small rival societies, which for domestic reasons are obliged to expend money and energy on objects which have no direct influence on bird life. Thus the full help and support of the newly formed British Trust for Ornithology, launched at the International Ornithological Congress at Oxford in 1934, which is designed to bring together all interested in British birds into one working union, is essential to the successful preservation of British bird life in the future.

New Lines in Building Construction.

Residential accommodation in England has made enormous advances in recent years, and blocks of flats of ultra-modern design, but without the somewhat ungainly eccentricity of their counterparts in Germany and elsewhere, have risen in large numbers, especially in the neighbourhood of London. Among the most recent is the block in Hampstead designed by Mr. Wells Coates for Isokon, Limited (*i.e.*, Isometric Unit Construction). Here the most noteworthy external feature is the series of entrance galleries, supported on cantilevers and connecting with the main stairway, which obviate the waste of internal space on corridors, etc. An internal staircase at the other end is provided with a continuous vertical light. All the main furnishing equipment is included in the rent as "fixtures"; and most of the flats are of the "minimum" type, no provision being made for families even of modest modern proportions.

Hotel construction in the British Isles, with the possible exception of the new railway hotel at Morecambe, has so far followed traditional lines. In Italy, however, where a more spacious landscape encourages such a course, a bolder note has been struck. At the comparatively new Alpine resort of Colle di Sestrières, a few miles from the French border, a couple of "tower-hotels" have been built. A feature of both of these is the absence of stairs; in addition to the lifts, approach to the upper floors is provided by a helicoidal ramp ascending at a gradual slope. All the bedrooms are of equal dimensions, and in the newer hotel they are separated from the central well by anterooms which serve as a sound-buffer. The idea of a gentle spiral ascent is not new; it appears in the entrance-tower of the Château d'Amboise (perhaps at the suggestion of Leonardo da Vinci, who died there), but its application to the strenuous pleasures of modern life is an interesting development.

Exterior galleries and stairs save valuable indoor space in these Hampstead flats.

The new "tower-hotels" at Colle di Sestrières in the Italian Alps, with a background of ski-slopes.

The British Association at Aberdeen.

By Our Special Correspondent.

Outstanding papers read at the Aberdeen meeting of the British Association are here reviewed for the benefit of those readers who were unable to attend. The general public interest of the papers cannot be too strongly stressed, and the Association has more than maintained its reputation as a public benefactor.

PROBABLY in no city in the British Empire is the balance between civic dignity and academic distinction so well maintained as in Aberdeen, and it is fitting that so appropriate an assembly-place should have been chosen three times for the meeting of the British Association. Few of those present, except for Principal Adam Smith and one or two others, can have had any vivid recollection of the last meeting, forty-nine years ago ; but in any case the success of this year's meeting could hardly have been exceeded, even in the glowing light of memory. At the inaugural meeting, Sir Josiah Stamp, the General Treasurer, was able to announce a membership of close on three thousand, and, as many of the papers read dealt with subjects of popular interest, accommodation was often strained to the utmost, though rarely did it prove insufficient.

The Presidential Address, delivered by Sir James Jeans, has already been widely reported in the Press, and, ranging as it did from the abstrusest points of scientific philosophy to a timely warning as to the practical future of Science, it attracted a well-deserved amount of both scientific and popular interest and a considerable quantity of controversy. In its widest significance the Address marked the end of the old absolutist materialism of the 19th century ; not that "materialism is dead," as the President was careful to point out, but "both materialism and matter need to be redefined in the light of our new knowledge."

The End of a Controversy.

During the past year *Discovery* has given the hospitality of its pages to a controversy on Science and Religion, and Sir George Adam Smith, in his sermon before the British Association, following the Presidential Address, chose this very controversy as his theme—or rather the approaching end of the controversy in the striking return made by leading men of science towards the Christian standpoint of faith in a Personal Creator of all matter. Sometimes, he said, the vision of a personal God had been denied by a philosophic pantheism which refused personality to the Divine immanence, and sometimes by a crude materialism, but a change had come over modern scientific thought. Biologists and the leading authorities in physical science and mathematics now supported neither pantheism nor materialism.

There was no just reason, the Principal declared, for supposing that evolution meant the denial of a personal God. On the contrary, religion was deeply indebted to science. In the proved gradual evolution of the universe and the proved gradual ascent of man there was every proof of a Creator. Professor Haldane wrote that the analysis of our experience led finally to the conclusion that the universe was a manifestation of God and that God was the personality of personalities.

Nothing had been more striking in recent years than the growing dissatisfaction of physicists and mathematicians with merely material conceptions of the world and man. It was they who among all men of science to-day might be regarded as the most powerful authors of the convergence of science upon religious explanations of the universe and upon the probability of a personal Creator.

Science the Benefactor.

In the concluding words of his Address, Sir James Jeans flung down a challenge to those who maintain that Science is harmful to the human race ; he reminded us that "new inventions add to the comfort and pleasure, health and wealth of the community." And in general the papers read before the various sections bore out his thesis in that they laid stress, so far as possible, on the human aspect of scientific progress.

In Section F, which deals with Economic Science, and is therefore perhaps most immediately concerned with human affairs, Professor H. M. Hallsworth, President of the Section, chose "The Future of Rail Transport" as his subject. Reviewing the difficulties with which railways have recently been faced he called attention to competitive enterprises : road transport, of course ; transport by air, which seems unlikely to provide serious competition *unless subsidised* ; and coastwise traffic, the development of which, thanks to the construction of shallow-draught vessels with Diesel engines, has been making enormous progress in an inconspicuous way and has won little notice in the Press. His solution of the transport problem lies in an approach towards the "ideal distribution" of traffic, road, rail, and sea bearing those loads most suited to them, with a system of charges varying according as the particular demand for transport services increases or diminishes the load

factor. The best solution, he considers, is that railways should cease to be regarded merely as *railway* companies, but as *transport* companies; the formation of the London Passenger Transport Board was a step in this direction in so far as passenger transport was concerned.

Sir Josiah Stamp, in the allied Department of Industrial Co-operation, took a leading part in a discussion on "The Need of a Technique for Economic Change," pointing out the need for elasticity under conditions of increasing population. Demand for new products implied a lessening of demand for old products, with a consequent displacement of employment; and a number of palliatives for this condition came under review.

The History of Light.

In Section A (Mathematics and Physical Sciences) Professor H. M. Macdonald made an important but difficult subject widely interesting in his Presidential Address on "Theories of Light." His historical survey ranged from the emanation theory of Empedocles and the undulation theory of Aristotle, both revived at the Renaissance, through the corpuscular theory of Newton, to the analytical mathematical methods of the past century, leading to the postulation of an all-pervading medium, Faraday's æther.

Dr. F. W. Aston's paper "The Roll-Call of the Isotopes" reviewed the latest discoveries in this direction. The main isotopic constituents are now known for all but four elements—palladium, iridium, platinum, and gold. The isotopic complexity of elements of odd atomic number shows a remarkable regularity. Excepting hydrogen, none of these has more than two isotopes. On the other hand, elements of even atomic number may be much more complex, tin having as many as eleven isotopes, and it is an interesting speculation whether or not the number may be extended indefinitely by increasing the delicacy of the methods of detection.

Mr. J. M. Stagg's records of the British Polar Expedition to Fort Rae (1932-33), including photography of auroral phenomena, were of the highest interest. Mr. C. R. Burch, in a somewhat inaccessible basement room, staged a continuous demonstration of Professor Zernike's phase-contrast method of microscopic illumination, together with his own adaptation of the principle to telescopic work. The joint meetings of Sections A and G were of the greatest importance in the advance of modern engineering.

Professor T. M. Lowry, addressing Section B as its President, evoked with pleasure the renewal of the old intimate fellowship between Chemistry and Physics, citing the theory of atomic numbers as the most important contribution which Physics has made to Chemistry during the present century. He concluded with an important consideration of those examples of "Physical Methods of Chemistry" with which he himself had been most closely concerned. Of other activities of Section B the most generally interesting was the Discussion on Ascorbic Acid (Vitamin C). The easy preparation of this substance, vital to human health from paprika was the result of the investigations of Professor A. Szent-Györgyi, of Budapest, who himself took a prominent part in the discussion. So recently has ascorbic acid become available for medicine that its medical applications are not yet fully settled; but the first clinical experiments have revealed some very striking and unexpected effects, including the possibility of remedying several diseases against which medicine has so far been helpless. Of these the most familiar are pyorrhœa and hæmophilia.

Another discussion of more than technical importance was that on the Chemistry of Milk, held jointly with the Agricultural Section (M). Dr. J. F. Tocher wisely remarked that "legal enactments should follow scientific knowledge, not precede it." The present regulations were made at a time when no accurate knowledge existed of the observed minimum limits of certain constituents of milk, and cases had even occurred when genuine milk had been held to be "watered.' Dr. S. K. Kon contributed interesting observations on the seasonal variation of the vitamin content of milk.

Granite in all Aspects.

Sections C (Geology) and E (Geography) devoted a fair proportion of their time to the consideration of the Aberdeen district. Professor A. W. Gibb enlivened his account of the local solid geology with some local anecdotes: the "Devil's Bit" occurs also in Scotland. The granites of Aberdeenshire were dealt with fully and a practical demonstration of their working was enjoyed by those of the Section (and others) who visited the famous Rubislaw Quarries. A hair-raising trip in the "Blondin" carrier down to the quarry-face (370 feet below ground) and up again provided much entertainment. Professors W. S. Boulton and P. G. H. Boswell stressed the urgent need for a proper survey of underground water-supply, owing to the increasing demand for water both domestic and industrial; important plans were formulated for a research organisation. Professor W. T. Gordon's Presidential Address included a fascinating historical study of the development of palæobotany and its relation to the philosophy of geology.

Among the geographers the Lord Provost's and Mr. J. Cruickshank's papers on the Aberdeen Joint Town Planning Scheme were followed with keen interest; practical illustration of the success of the scheme was afforded on the week-end excursions.

Professor A. G. Ogilvie's address as President of Section E dealt with Co-operative Research in Geography, the stage succeeding the pioneer work of exploring. *Discovery* never wearies in its policy of recommending maps and more maps; and it was heartening to hear Professor Ogilvie reiterating the firm conviction of geographers that scientific knowledge of the continents can scarcely begin until they have been adequately mapped. The idea of extensive collaboration in geographical research, he said, is by no means new. An obvious method which has been employed consists in the concentration upon a given region of work by specialists in each of the earth sciences, resulting in a series of individual monographs. But unless there be a concluding volume in which all the results are causally linked, the work is not geography.

Major Hotine, speaking of "National Maps as Backgrounds," gave a welcome advertisement to the scientific side of the work of the Ordnance Survey; and Professor Fawcett studied the relations between the advance of geographical science and the life of the community; advances in geography led to the use of materials otherwise unknown, the development of fisheries, the knowledge of sources of water supply, and the extension of methods of communication. This year's drought was largely caused by the failure to apply the existing knowledge collected by geographers.

Dr. E. S. Russell's address to Section D, on "The Study of Behaviour," continued Dr. James Gray's discussion of the previous year, in which he maintained that "the conception of the organism as a single living entity is or should be the more peculiar attribute of experimental biology."

Matter and Mind Discarded.

The study of animal behaviour has been somewhat neglected in this country, although excellent work in the field of scientific natural history is being done by the animal ecologist, by economic workers, and by the amateur naturalist. Dr. Russell discarded both "matter" and "mind" as abstract notions of little real use in biology, and maintained that the concept of "organism" was a more useful one for purposes of biological research. "From the organismal standpoint there is no difficulty in assuming that animals perceive and react to an external world of their own; here, as in our own case, perception may be regarded as a function of organism, not of 'mind.'"

"The 'plain tale' description of animal behaviour must begin with a study of the natural history and ecology of the animal. Most animals are restricted to one definite and rather specialised kind of environment; they are adapted both in structure and activity to inhabit some particular ecological norm or ecological niche. We must discover by field observation how the animal finds this ecological niche to begin with, and how it maintains itself therein. We must investigate how it counters changes in its environment, how it defends itself against enemies, how it finds or captures its food."

Dr. Russell concluded his most stimulating and suggestive address by a series of examples illustrating the stimulus-response by which animal behaviour is instigated. Mr. A. G. Lowndes's paper on the movement of ostracod spermatozoa was of not merely biological interest, as the infinitesimal movements of the sperms were illustrated on the screen by a cinematic invention of the author's own, which we hope to discuss later in the pages of *Discovery*. The afternoon discussion on the inheritance of productivity was of great agricultural importance, and a final discussion, with Section J (Psychology), followed up the President's paper in the interpretation of animal behaviour in accordance with the two questions: (i) what mental experiences do animals possess? and (ii) what are the causes of animal actions?

Noise: the Baffling Problem.

Professor F. G. Baily, President of Section G, directed the attention of engineers to Sources of Cheap Electric Power, the extravagant waste of coal affording him a text from which to start. The proper utilisation of industrial steam and water power were likewise brought under review. Mr. R. W. Allen, dealing with Diesel engines in trawlers, brought the Engineering Section into line with the Economic Section. The Diesel engine gives the trawler a great range of action, just as it enables coastwise traffic to visit ports previously inaccessible. The much-advertised discussion on the reduction of noise was largely attended, but the results were somewhat disappointing, in that no very effective or original scheme for noise-abatement was formulated. It is probable that the public were expecting too much.

Section H (Anthropology) suffered a serious loss in the absence of its President, Captain T. A. Joyce. Lord Raglan ably deputised, and his paper on "The Cult of Animals" was as amusing as it was informed. He divided the religio-sociological aspect of animals under eight heads, noting that in each case there were human and animal alternatives. The main point was that real people were never identified with real animals, but the whole series of animal cults was an elaborate system of symbolisation, non-animal symbols also being used as substitutes (e.g., vegetable instead of animal totems; stones as gods; stars, etc., as emblems). Professor McIlwraith read a delightful paper on the Bella Coola Indians of the Pacific Coast of Canada—a pleasant

surprise as this paper was not included in the programme. Especially remarkable was the way in which these Indians regard myths as important family property, so that a woman possessing a rich inheritance of myths finds it easier to get a husband than one who is beautiful or well supplied with worldly goods. Mr. J. C. Clark presented a paper on a 16th century Aztec manuscript, with some beautiful illustrations.

Sections I (Physiology) and M (Agriculture) united in a joint symposium on "Nutrition in Relation to Disease," and, as has latterly been the principle of the Association, the discussion started with a short non-technical account of the broad principles of nutrition. In this Dr. J. B. Orr suggested that the present generally accepted standards of health are too low. If the necessary measures could be taken to ensure that every member of the community had a diet which was fully adequate for health, the next generation would be of better physique and free from much of the disease and indefinite ill-health which afflict the present generation.

Mr. H. T. Tizard's presidential address to Section L (Educational Science), on "Science at the Universities," was of the highest importance. It came perhaps as a shock to some of us that it is not so long since it was considered not quite respectable to be a scientist at a public school. That state of affairs is happily past, and Mr. Tizard claims that science, well taught, can supply all that is best in the classical tradition; can "teach accuracy and exactness; can give a discipline in clear thinking; can teach boys to recognise differences in things which seem alike; can brace with its difficulties minds that are not afraid of difficulties; can inspire with its beauty minds not insensitive to beauty"—quoting the recent words of the Head Master of Rugby in praise of Greek. After reviewing the cost of the teaching of science, and the future of scientific graduates of the universities, Mr. Tizard made a plea for a School of Science as a general education, somewhat on the lines of Modern Greats at Oxford, including the philsophical background of Science, its history and its practical applications to life. The student in short is to learn that Science is "nothing but trained and organised common sense." Mr. Tizard would, in fact, apply to Science in Education what the British Association applies to Science in practice.

It is impossible in the brief space at our disposal to give more than an outline of a few of the activities of the British Association, and attention has been given somewhat arbitrarily to those which seemed to have the widest appeal. Professor W. W. Watts has been chosen to succeed Sir James Jeans as President for the ensuing year.

Notes on Radiolymyia.

By Our Special Correspondent.

Specially interesting exhibits, or those incorporating new ideas, designs, and greater efficiency, have been examined; and a few of the more important are here described.

Electro-Dynamic Sound Reproducers. Makers of loud-speakers have all exhibited their new designs among the various types of moving coil instruments. Mention is made here of a few of those more refined designs that attract attention specially. Messrs. Celestion, well known for the production of high class loud-speakers, have some very interesting and much improved exhibits. Their Auditorium speaker is a superb piece of workship, with a cone of about 12 in. diameter or more and means of matching up by use of terminals mounted at the rear: the gross weight of the A.C. model is 74 lb. 8 oz. and of the D.C. model is 70 lb. 8 oz.—an electrically energised instrument. The Celestion model S.29 loud-speaker combines a large cone and a small one, both entirely separate, the whole being designed to give accurate reproduction over the whole audible frequency band. This S.29 speaker is a permanent magnet outfit and is therefore ideal for the battery-set owner who likes good results; a high note volume control is fitted. Goodmans' new "12 Watt" permanent magnet moving coil speaker gives very good results; is capable of handling up to 12 watts undistorted input and has a totally enclosed voice coil, a rather important point. Twelve tappings are fitted to give an impedance range of 1.6 to 25,000 ohms for power valve and pentode output with four tappings for QPP, Class B and Push Pull systems, viz., 7,000, 10,000, 16,000 and 25,000 ohms. Messrs. Blue Spot have a loud-speaker which is comparable with the Celestion S.29 model, except that the large and small cones are mounted concentrically. It is called the "Super Dual" and is made in permanent magnet and D.C. energised models. The 2-in. speech coil attached to the 11-in. cone works in a flux density of 11,500.

Insulation Material. The material termed "Telecconite," made by the Telegraph Construction and Maintenance Co., Ltd., is an insulated wire, the insulation being over tinned copper. The insulating resistance is over 50 megohms per linear mile; the specific inductance capacity under 3.5; and the breakdown voltage over 5,000 volts A.C. The material will stand moisture and prolonged damp and is unsuitable for temperatures over 130° Fahrenheit.

Further notes on recent radio developments will be included in our November number.

Book Reviews.

The Families of Flowering Plants: II. Monocotyledons. By J. HUTCHINSON, F.L.S. (Macmillan. 20*s*.)

Reviewed by Professor A. C. SEWARD, Sc.D., F.R.S.

After reading the Preface and turning over the pages of this volume one wonders how the author has been able to produce it: there are not many botanists or, indeed, many men of science occupying positions where most of each working day is devoted to official duties, who are able in a comparatively short time to make substantial and original contributions to knowledge. Mr. Hutchinson's first volume, on Dicotyledons, was published in 1926 and now after eight years, fourteen months of which were spent on botanical expeditions in Africa, we have the volume on Monocotyledons. Moreover, as the author tells us, he had not previously given special attention to Monocotyledons and had to "plough the sands" in order to prepare the new classification which is an outstanding feature of the volume. He has produced a most valuable book of reference, a work distinguished by originality, severe and concise in style and generously supplied with exceptionally attractive illustrations drawn by the author. It is not an elementary text-book, but a book that will be cordially welcomed by teachers and advanced students, and by all who are interested in the taxonomy of flowering plants. The present volume adheres to the plan adopted in the earlier work: the guiding principle followed by the author is the establishment, as far as possible, of a phylogenetic system; to arrange the families in a natural sequence, "starting with the most primitive and ending with the most advanced types."

Systematic botany, as it is often called, is primarily concerned with the arrangement of the vegetable kingdom in classes, groups, families and genera in such manner as to enable us to assign individuals to their respective places in a system, whether artificial or natural. All systems must be, in a greater or less degree, artificial; we can only guess at the course of evolution and seek for the hypotheses which work best. Mr. Hutchinson has made a courageous attempt to reconstruct genealogies and to select characters which are believed to be the surest guides to affinity; his views will stimulate discussion, and whether or not they find favour with his brother systematists, they cannot fail to advance knowledge and contribute to a clearer understanding of the mysteries of creation. One example of his provocative and suggestive methods must suffice: we have long been accustomed to regard the superior or inferior position of the ovary in the flower of a lily and a snowdrop respectively, as the important distinguishing feature of the families Liliaceæ and Amaryllidaceæ; and most of us have not questioned the validity of this character as a hall-mark of affinity. Mr. Hutchinson is a botanist who is not unduly impressed by tradition and authority; he thinks for himself and is bold enough to question time-honoured conclusions: having satisfied himself that the position of the ovary is too simple a test to be true and that it separates closely related genera, he selects the inflorescence as the more trustworthy guide to the course of evolution and as a more satisfactory basis on which to found a Natural Classification. He transfers the familiar South African *Agapanthus* and the onions with their allies from the Liliaceæ to the Amaryllidaceæ. Experts will no doubt have much to say on this revolutionary proposal, but it is greatly to the credit of the author that he has grappled with the difficult problem of relationship in a spirit worthy of the best traditions.

The Director of Kew in his foreword speaks of the appreciation by botanists of the value of Mr. Hutchinson's work embodied in Vol. I: of this there can be no question. He goes on to express the rather surprising opinion that botanists generally are in agreement with the author's conclusions as given in the first volume. It could hardly be expected that any scheme of classification would gain general acceptance in the course of eight years: Mr. Hutchinson may be right and his views may prevail, but the point is that there are and must be wide differences of opinion on such a subject as classification. Optimist as he is, our author knows enough of the human nature of his colleagues to realise the true position. Complete agreement is a dream: the reality is progress through trial and error and tentative suggestions which will either become accepted as probabilities or by their rejection clear the ground for a further attempt at construction.

Mr. Hutchinson gives concise descriptions of families and genera, with numerous keys as aids to identification; he also gives many admirable maps showing the geographical range of families and a few selected genera—a particularly welcome feature. He considers herbaceous Monocotyledons more primitive than arborescent forms – a reversal of the order of evolution postulated for Dicotylelons— and supports his belief in the close relationship of Monocotyledons and Dicotyledons by comparisons of families, e.g., the Alismataceæ and the Ranunculaceæ (sub-family Ranuncubideæ). The volume is strictly taxonomic in treatment; it deals with vegetative and reproductive characters and makes brief reference to distribution and economic products: the author is not concerned with the Natural History or biological aspects of plants.

A book such as this is especially valuable in that it enables students to take a comprehensive survey of the whole class. There is a natural tendency on the part of students to base their conception of flowering plants on the British flora, forgetting how insignificant that is in relation to the floras of the whole world.

The author expresses indebtedness to Mr. C. E. Hubbard, Mr. V. S. Summerhayes, and Mr. J. E. Dandy for contributions; he is fortunate in being able to thank two daughters for their co-operation. The volume is most appropriately dedicated to "Agnes Arber of Cambridge in recognition of her classical researches on Monocotyledons." Mr. Hutchinson has rendered a great service to botanical science and has also demonstrated the truth of the saying that no man is too busy to do what he really wishes to do.

Field Studies in Ecology. By R. BRACHER. (Arrowsmith. 2*s*. 6*d*.)

The publication of a book such as Miss Bracher's *Field Studies in Ecology* is pleasing evidence of rapid growth of interest in the subject which has been called "Scientific Natural History." The principle seems now clearly grasped by biological educationists of all kinds of status, that students benefit by direct contact with plants in their natural environment, and are keenly interested in ecological field-studies. It is possible for school children to employ wild species almost as easily as those of garden plants, in studies not only of morphology of parts such as seeds, fruits, roots and perennating organs, but also in experiments on transpiration, germination, and other physiological processes. Senior

school students can be encouraged to take into the field the means for quantitative estimations of the plants themselves and of major environmental factors such as may be expected to be major determinants for the chief plants or plant communities. It is the virtue of Miss Bracher's book that it is evidently the outcome of much experience with students in field classes, and it describes the technique of a limited series of observations with the confidence born of actual practice. It should be extremely useful to schools and possibly also to first-year students in university classes.

It is a characteristic of the subject that it is far easier to record physical factors and vegetational distribution than to apply the former to a proper interpretation of the latter. In this task the competent teacher needs all his skill and vigilance in order to maintain in the student a sufficiently scientific outlook. Miss Bracher attempts to give none of the theoretical side of the subject at all, and the teacher will therefore need to use also one of the existing introductions to ecology.

The book is remarkably cheap at half-a-crown, and its illustrations, printing, and format reflect great credit on both author and publishers. It ought to prove stimulating and useful.

The National Plans (10-foot, 5-foot, 25-inch, and 6-inch scales). By BRIGADIER H. ST. J. L. WINTERBOTHAM. (H.M. Stationery Office. 4*s*. 6*d*.)

This valuable historical and technical summary, from the pen of the Director-General of the Ordnance Survey, is No. 16 of the New Series of Professional Papers issued by the Ordnance Survey Office at Southampton. With the interest in the countryside rapidly increasing in latter years, the work of the Ordnance Survey has become more familiar to the man-in-the-street; but it is the one-inch map that is generally in his hands. The series of maps under review are the marvellously accurate larger scale plans, on which every detail of the lansdcape, natural or artificial, falls to be indicated, and which are used mainly for land registration and valuation, special boundary surveys, town-planning lay-outs, and such purposes.

Brigadier Winterbotham quotes liberally from the reports of various commissions and committees convened to discuss the terms of reference of the Survey, such quotations often proving markedly apposite:

"The public, not unnaturally, expects that a map published with Government authority shall accurately represent existing fact."

"The public must be prepared to use obsolete maps of some of the most important counties of England."

These quotations juxtaposed give some idea of the circumstances in which the Ordnance Survey is expected to work; often, too, an authority anxious to expedite some particular survey deprecates meticulous accuracy and urges both haste and economy. That the Survey, despite staffs depleted by the "Geddes axe" and other "economy drives," manages to maintain a high standard of up-to-dateness and accuracy, is a matter for congratulation. It is encouraging to read that "responsible character and highly trained craftsmanship . . . will be with us for many years"; yet it is perhaps disheartening though scarcely surprising that almost every effort towards economy should result in a marked reduction in efficiency. "The progress of the Cadastral Survey is exactly proportional to the amount of money voted by Parliament for its prosecution."

It is another "injustice to Ireland" that we do not all realise that the first large-scale (6-inch) survey of these islands was made in Ireland, for the purpose of an accurate valuation of "townlands, colps, greeves, bullibos, bullibellas, cartrons, tates," and other divisions of land. Major-General Colby, then Director-General, who carried out the survey, laid down for Ireland the general principles of large-scale surveying in Britain. This was in 1825; the first 6-inch survey of England was not begun until 1840. "The Ordnance Survey of Ireland is considered one of the most valuable acts of government that has ever been carried out in Ireland."

Brigadier Winterbotham takes us through the "Battle of the Scales"—the confusion in which some parts of Great Britain were surveyed on the 6-inch scale, some on the 25-inch (begun 1853)—down to the comparatively static period of to-day. The problems of spelling, drawing, typing and stamping, paper, and ink are successively dealt with, and the new developments in the antiquities department are amply described. It is here that air photography has found its fullest use; for ordinary surveys on large scales photographs from the air have proved neither sufficiently detailed nor economical. A detailed chronology summarises the history of the large-scale survey; the illustrations are, as might be expected, informative and beautifully produced.

Design in Modern Life. Edited by JOHN GLOAG. (Allen & Unwin. 10*s*. 6*d*.)

In 1933 the B.B.C. broadcast a series of discussions on the many aspects of modern life in which design plays an important part. There were invited to the microphone nine experts who, under cross-examination by "Listener's Friends," revealed their opinions. Mr. James Laver, of the Victoria and Albert Museum, poet, playwright and novelist, dealt with the design of Clothes; Mr. Francis Meynell, the typographer, with "The Printed Word"; and Mr. Gordon Russell, the furniture designer, with "The Living-Room and Furniture." "The Kitchen" was in the capable hands of Miss Elizabeth Denby, and "Dwellings" were discussed by Mr. Wells Coates, whose new block of flats in Hampstead is the cause of much comment at this moment. Mr. A. B. Read, art director of a leading firm of lighting engineers, spoke of "Light"; Mr. Robert Atkinson, at that time head of the Architectural Association Schools, was drawn out on the subject of "Theatres, Cinemas and Public Buildings"; and Mr. Maxwell Fry, well known for his spirited propaganda for town and regional planning and an architect of repute, made an appeal for better design in the countryside and the town. Mr. Frank Pick, the President of the Design and Industries Association, and himself responsible for that supreme example of orderly design, London's Underground, spoke on "The Street," and rounded off the series with a clear jargon-free summary of the whole question.

The talks aroused a great deal of interest throughout the country. Exhibitions were held in various places to illustrate many of the points dealt with by the speakers, and finally the Exhibition of British Industrial Art held at Dorland Hall in June, 1933, demonstrated that the precepts of the experts can be, and are, applied by the manufacturer so as to produce, in this country, articles of everyday use which, though machine-made, are not mere imitations of the styles of earlier days, but, through systematised examination of contemporary needs, are an expression of those needs in terms of contemporary materials and methods of production.

Undoubtedly there is an awakened interest in the public mind in all questions of design and a realisation, rather vague as yet, of the important part it must play in the economic and social planning of our time. To-day town and regional planning and the preservation of the countryside are subjects for ever under discussion. The need for decency in the design of dwellings and their interiors lags behind, but it cannot be long before the incongruity of the sham-Tudor house with the 1934 interior is generally recognised.

Mr. John Gloag, who took a leading part in organising the radio discussions and himself played the part of "Listener's Friend" in three of them, has now collected the contributions of the experts (with the exception of those by Mr. Wells Coates and Mr. Francis Meynell) and translated them from the colloquial dialogue in which they were originally delivered into a very readable prose. He has added a stimulating preface entitled "Who knows what the public wants?" and Mr. Maxwell Fry has written a chapter on the design of dwellings, tracing the growth of the domestic house from the elementary cottage to the new multiple-flat dwelling which is the solution of our present problem of over-crowding. The many excellent illustrations help to make up a volume which should be on the shelves not only of those who followed the broadcast discussions and would like this permanent record of them, but also of all who care for beautiful things and would like to know how they can be attained in a machine age.

The "Progress and Period Charts" at the end of the book, prepared by Mr. Raymond McGrath, show pictorially the development from 1500 to the present day of everyday things. They should be framed and placed on the walls of every schoolroom in the country.

Habitat, Economy, and Society: A Geographical Introduction to Ethnology. By C. Daryll Forde. (Methuen. 15*s.*)

Rival theories of the origin and development of culture, especially in the cruder forms of argument, have, no doubt, brought much bewilderment to the layman; and some may have been led thereby to ask what profit there may be in ethnological speculation. In a sense Professor Forde supplies an answer to this question in attempting a reconciliation of the views of the diffusionist school with the facts of invention and discovery in cultural advance as revealed by the data of archæology. He shows further that the view of the evolutionary school which saw a simple advance from food gathering societies to the more complex forms of hunting, the pastoral life and cultivation, is no longer tenable in its more or less hard and fast lines. He describes a number of the simpler modes of life among primitive peoples in various parts of the world and shows that even in the simplest society the factors implicated in its development are more complex than was appreciated by earlier investigators. Hence, for the author, it is not a question of diffusion as against independent development. The problem as he sees it is one in which geographical environment, diffusion, and social and economic forces all have to be taken into account.

Professor Forde's book is of the greatest value to the student and of no less interest to the general reader. His careful examination of the archæological evidence for the origin and development of the elements of culture such as agriculture, the domestication of animals and plants, the use and working of metals, and the like, is a careful and well-balanced study of the latest evidence of research.

Wisdom in the Wild. By Douglas Gordon. (Murray. 7*s.* 6*d.*)

Mr. Douglas Gordon is well known as a stimulating writer upon wild life and a good field naturalist. In the present volume he writes of the mentality of animals and birds, and endeavours to interpret their motives. In so doing he quite rightly controverts the too humanistic interpretation of animal behaviour which has often led sentimental writers into error, and has given the public grievously incorrect ideas as to animal and avian psychology. As Mr. Gordon says in his foreword, "their ways are not our ways, nor their thoughts our thoughts." Or, as George Meredith put it, they are "nearer to earth than we."

Writing of the higher qualities of animals, Mr. Gordon says "it is difficult to understand the prevailing desire to 'humanize Nature,' or the disfavour with which any reference to the automatic character of wild procedure is apt to be regarded. . . . Achievement in defiance of limitation, perfection without tuition, and conformity to law without visible coercion or restriction, constitute a state of affairs no less remarkable, although in no way comparable with human life, even when the latter has attained the very acme of civilisation." This is true enough: at the same time, though Mr. Gordon stresses the unconscious and instinctive element in animal behaviour, he is not to be classed in that school of thought which would interpret all animal behaviour in terms of tropism or reflex action. He admits "some slight difference in the conduct of individuals . . . for no two creatures either physically or mentally are *precisely* alike."

Animal behaviour is almost entirely instinctive; more rarely it is intelligent; seldom or never does it attain to reason. Admitting this, it is still permissible to doubt whether animals or birds are entirely slaves to custom; especially does individuality become noticeable among birds when observed under natural conditions and at close quarters. Mr. Gordon's account of his tame robin shows clearly enough how this bird had a distinct individuality, and many other instances could be quoted from our own experience.

The book has a wide range. It includes chapters on "the Wild Creature's Attitude towards Mankind," "Affection," "Friendship," "Co-operation." "Language," "Orientation and Migration," "Vision" and "Limitations"—all of which arouse interesting speculations. Mr. Gordon's great experience enables him to illustrate his theories with a wealth of example. It should sustain his already high reputation as an author and naturalist.

The Preservation of Antiquities. By H. J. Plenderleith. (The Museums Association. 2*s.* 6*d.*)

The application of scientific methods for cleaning and restoring antiquities is gradually spreading throughout the provincial museums. In this country it first received attention at the British Museum, where a laboratory was established about ten years ago. In the intervening years three special reports relating to the problems that arose were published by the Department of Scientific and Industrial Research. The principal methods employed have now been presented in concise form in this handbook, the first of a series that the Museums Association is publishing upon subjects of interest to the museum curator. To those who are working in the interest of any archæological collection the information given will prove of good service, for it provides the fundamentals of museum laboratory technique in so far as it relates to the preservation of antiquities.

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